

PROFESSOR E. T. COX:

*State Geologist:*

DEAR SIR:—Herewith I submit my report on the geology of Warren, Lawrence, Knox and Gibson counties, and a paper on the Tripoli beds of Dubois county.

Returning my thanks for your many courtesies, I remain

Yours truly,

JOHN COLLETT.

NEWPORT, IND., March, 1874.

# GEOLOGY

OF

## WARREN COUNTY.

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BY JOHN COLLETT.

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### TOPOGRAPHICAL DESCRIPTION.

This county is located in the middle northwestern part of the State. It is bounded on the south by Vermillion, southeast by Fountain, east by Tippecanoe, north by Benton, and on the West by the boundary line between Indiana and Illinois, and contains 360 square miles. Several good mill streams, as Redwood, Rock, Kikapoo, Pine and Little Pine creeks, have their sources near the western or northwestern parts of the county, and flowing in a southeasterly direction, fall into the Wabash. These, with many smaller creeks, furnish an abundance of water. Springs frequently burst forth at the junction of the Boulder drift with the underlying rocks; while the drift itself is seamed with partings of quicksand, which, charged with underground streams at deep cuts, or pierced by wells, furnish an unfailing supply.

The topographical features of the county are agreeably varied. The western and northern parts, embracing

more than half of its area, present a broad stretch of Grand Prairie in a prairies' most favorable aspect. Its soil is deep, black, and produces, without manure, in unlimited succession, large crops of corn, oats and grasses. The surface is undulating or gently rolling, and offers ample facilities for drainage, without any "waste" land whatever; while from the tops of any of the slight knolls or prairie ridges, the eye is delighted with miles of corn fields, or leagues of blue grass pasture and meadow land, diversified with island groves or their partings of timber. Adjoining the prairie region to the south and east, is a wide belt of high, rolling or hilly land, that descends gently to the abrupt or precipitous bluffs, bounding the valleys which the Wabash, and the creeks which flow into it, have cut down through the underlying coal measures—through the conglomerate sand rock, and deep into the sub-carboniferous formation. The soil of this belt is mostly yellow clay, formed by decomposition of Silurian, Devonian, and sub-carboniferous lime rocks, imported by rivers anciently flowing at this level. It is rich in tree food, and was originally clothed with a dense forest of oak, hickory, ash, walnut, poplar, beech, maple, and other large trees. Beech and sugar tree predominating on the reddish clay soils, and oak trees on drift clays or sandy soils.

The bluffs along the Wabash river and the principal creeks are from 80 to 150 feet in height, and are of romantic boldness. The tops at several stations are crowned with pines and cedars, and the sides are generally curtained by living walls of conglomerate or sub-carboniferous sand rock.

The river and streams are belted by "bottoms" characteristically fertile. These were originally covered with a heavy growth of walnut, burr-oak, hackberry, maple, cottonwood, sycamore, buckeye, elm, spicewood and pawpaw. Cleared and improved, these bottoms produce satisfactory crops of corn, grasses and potatoes.

## GEOLOGY.

*Surface Geology.*

The surface deposits of this county comprise two members of the *Quaternary* or most recent of the geological formations, viz: *Alluvium*, new, or ancient, and the *Boulder drift*.

The alluvial river bottoms owe their origin to causes now in action. They are formed of sedimentary sands and clays torn away and transported by streams at a stage of high water and thrown upon their flood plain by overflow. The soil is quite sandy, but largely intermixed with decayed leaves and other vegetable matter, it is in effect a rich, warm calcareous loam or garden mould.

At an elevation of from 60 to 90 feet, near the present channel of the river, are found wide areas of the *more ancient* alluvial formation; as the Mound Prairie, opposite Covington, and the "barrens" adjoining, the valley bottoms extending south from Williamsport, along the railway line to Rock creek and near the mouth of Redwood, and the bench of "barrens" south and west of Independence. The soil of this formation is generally a warm, black loam, but sometimes, as near and west of Independence, sand and colder clays predominate. It is underlaid by gravel, sand, or rounded fragments of sandstone, and from the wide range of the deposit extending miles on either side of the river, from the great depth and uniformity of the material, we may date back the age of these terraces to a period when they constituted the flood plains of the Wabash, then a mighty river, miles in width, which bore, in a broad channel vexed with numerous islands of conglomerate sand rock, the surplus waters of Lake Erie, to the sea. Still higher reaching up to the most elevated points in the country and full 200 feet above the present bed of the river, are found the *oldest alluvium*—terraces and banks of modified drift, gravel and sand, (as at Walnut Grove, towards the northwest corner of the county, township 23, range 9).



These signalize the infancy of the river, when an insignificant and currentless stream, with uncertain course, the Wabash, traversing all the region from 30 to 40 miles on either side—sometimes flowing around through Illinois—sought, by the line of least resistance, the easiest pathway to the mouth of the valley of the continent.

The *Boulder drift* next succeeds in age. This formation is well developed in the west and northern parts of the county and in fact underlies all the Grand Prairie district. It consists of tenacious gray and blue clays, obscurely laminated, and holding a very considerable proportion of worn and polished pebbles and boulders. Some of the latter are specimens of the Devonian and Silurian rocks in northern Indiana and Illinois, but a larger proportion are metamorphic or transition rocks from the neighborhood of Lake Superior, or from still more Arctic regions. The boulders and coarse gravel are scattered from near the top down to within 5 to 20 feet of the bottom of the drift; for these clays were in a soft and oozy condition, and the heavy masses of granite would naturally sink some distance in the pulpy mass. As a consequence, when boulders are found on the *surface*, we may safely conclude that erosive action had carried away the finer matrix, leaving bare the heavy rocks. These in return, by their number, are a measure of the amount of denudation. Partings of quicksand and thin layers of stony fragments from neighboring strata are found located at large intervals through this formation; showing that for short spaces during the drift period, the great ice bearing stream from the north was obstructed or overpowered by cross currents from the east or from the west, thus mingling with the northern drift, fragmentary materials from Indiana, Illinois and Iowa. Near the base of the drift, and resting on a broken and irregular floor of coal measure rocks, is generally found a bed of potter's clay, somewhat intermixed with quicksand and black muck. A marked bed of the latter was met in sinking the West Lebanon shaft. From the soil or peat here discovered, a large number of roots of trees, shrubs and plants of pre-

glacial age were found in situ, specimens of which are placed in the State Cabinet. The foregoing deposits may be arranged in the following:

*General Sections of the Drift, etc.*

Soil.....	2 to	5 feet.
Alluvium, <i>recent</i> .....	5 to	12 feet.
Alluvium, <i>ancient terraces</i> .....	70 to	15 feet.
Boulder drift.....	50 to	175 feet.
Boulder clay and vegetable matter	10 to	5 feet.
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		212 feet.

PALEOZOIC GEOLOGY.

The visible rocky formations of this county commence nearly at the middle of the coal measures (coal No. 7 of Illinois or M. of Indiana) and extend down to about the top of the knobstone shales of the sub-carboniferous period, and may be classified in the following divisions:

CARBONIFEROUS AGE.

*Carboniferous Period.*

- (a) Coal measures.
- (b) Conglomerate sand rock.

*Sub-carboniferous Period.*

- (a) Chester sandstone.
- (b) St. Louis and Keokuk beds.
- (c) Knobstone shales.

These formations, gathered in detail from isolated stations in different parts of the county, may be grouped in connected section as follows:

## CONNECTED SECTION OF WARREN COUNTY.

No.		
1.	QUATERNARY.	Soil..... 10 ft. 00 in. to 2 ft. 00 in.
2.		Recent alluvium..... 20 ft. 00 in. to 5 ft. 00 in.
3.		Ancient alluvial terraces..... 70 ft. 00 in. to 20 ft. 00 in.
4.		Lacustral alluvial terraces..... 10 ft. 00 in.
5.		Boulder drift..... 30 ft. 00 in. to 170 ft. 00 in.

[Total Quaternary, 207 feet.]

6.	OUS.	Yellow flaggy sandstone, soft and micaceous..... 8 ft. 00 in. to 9 ft. 00 in.
7.		Hard ferruginous sandstone and iron stones..... 4 ft. 00 in. to 2 ft. 00 in.
8.		Black sheety slate..... 0 ft. 6 in. to 1 ft. 4 in.
9.	FER	COAL, M, pyritous, caking..... 0 ft. 10 in. to 1 ft. 8 in.
10.		Fire clay, with stigmarial rootlets..... 2 ft. 2 in. to 3 ft. 4 in.
11.		Soap stone and silicious shale, changing to argillaceous sandstone..... 5 ft. 1 in. to 18 ft. 4 in.
12.	NI	Fern bed, white soap stone..... 0 ft. 6 in. to 2 ft. 3 in.
13.		COAL L, averaging 2 ft. 9 in... 0 ft. 10 in. to 4 ft. 6 in.
14.		Fire clay, plastic..... 3 ft. 6 in. to 4 ft. 00 in.
15.	CARBO	Clay shale and ferruginous sandstone..... 8 ft. 00 in. to 17 ft. 00 in.
16.		Black bit. limestone, or calcareous shale..... 2 ft. 6 in. to 4 ft. 6 in.
17.		Black sheety slate, with pyritous ores.. 0 ft. 10 in. to 8 ft. 2 in.
18.		COAL K, average 3 ft. 2 in..... 2 ft. 00 in. to 3 ft. 8 in.
19.		Fire clay..... 3 ft. 1 in. to 3 ft. 6 in.
20.		Black clay shale, with bands and massive concretion of calcareous iron ore..... 30 ft. 00 in. to 8 ft. 00 in.
21.		Flaggy ferruginous sand stone, tracks of reptiles, sun cracks, and fucoids..... 12 ft. 00 in. to 8 ft. 00 in.
22.		Heavy bedded quartzose sandrock 8 ft. 00 in. to 14 ft. 00 in.
23.		COAL A..... 2 ft. 00 in. to 0 ft. 00 in.

[Total Carboniferous, 113 feet 3 inches.]

24.	CONGLOMERATE.	Laminated sand stone.....	8 ft. 00 in. to 20 ft. 00 in.
25.		Massive conglomerate yellow, red, white and striped with few pebbles.....	60 ft. 00 in. to 90 ft. 00 in.

[Total Conglomerate, 110 feet.]

26.	SUB-CARBONIFEROUS.	Dark aluminous and pyritous shale.....	5 ft. 00 in. to 18 ft. 00 in.
27.		Laminated thin bedded sand stones, and grit stones, chang- ing at north to silicious shales	10 ft. 00 in. to 24 ft. 00 in.
		Bands and nodules of clay iron ore, with coal plants and sub- carboniferous fossils.....	1 ft. 00 in. to 2 ft. 06 in.
28.		Impure limestone with fossils....	4 ft. 2 in. to 1 ft. 8 in.
29.		Red and green shales.....	3 ft. 6 in. to 2 ft. 00 in.
30.		Impure limestone.....	1 ft. 8 in. to 0 ft. 00 in.
31.		Clay shale.....	4 ft. 00 in. to 0 ft. 2 in.
32.		Yellow limestone, Keokuk and St. Louis.....	1 ft. 2 in. to 0 ft. 00 in.
33.		Clay shales, with lean iron ore...	1 ft. 00 in. to 0 ft. 8 in.
34.		Shale, siliceous, weathering dark gray or blue, with bands of chert. No fossils.....	20 ft. 00 in. to 40 ft. 00 in.
35.		Knobstone shales and sand stone to Wabash river.....	10 ft. 00 in. to 5 ft. 00 in.
		[Total sub-carboniferous, 91 feet.] — —	
		521 ft. 9 in.	

The surface deposits have already been considered under the head of Recent Geology. As there stated, they cover the entire area of the county. If it were not for the erosion of river and creek valleys, the rocky formations of this county could not have been seen. This explains the apparent limitation of stone or coal outcrops to the neighborhood of streams and rivers, while in fact though deeply covered, they exist in other parts as well.

#### SUB-CARBONIFEROUS GROUP.

This system is known by the name of *Carboniferous* limestone, and by the English geologists as the Mountain

limestone. It will be seen that these names, although generally proper, are here a seeming misnomer, as the system is composed almost wholly of siliceous material. This siliceous character predominates as well in northern Illinois. Here life was not abundant in the shallow muddy seas of the sub-carboniferous period, yet sufficient to fully determine the geological position of the rocks.

### *Knobstone Beds.*

Synonyms: Chemung, (Hall); Waverly, (Ohio); Kinderhook, (Illinois).

These beds No. 35 of General Section are largely developed in Southern Indiana at New Providence and at New Albany, where they were first studied by Dr. D. D. Owen. The name there applied of "knobstone group or beds," is peculiarly appropriate and taking precedence by priority, is retained. In this country they are slightly developed and without fossils as far as seen, and are identified from stratigraphic and lithological reasons alone. They consist of gray or dove colored shales and shaly sandstones, near low water mark in the Wabash, at and above Independence, and *below* the thin chert beds at that place, and Flint creek in Fountain county.

### *Keokuk and St. Louis Beds.*

These beds, Nos. 28 to 34 inclusive, are found in the bottom of the Wabash river, a short distance below Williamsport. Thence rising to the north and east, they exhibit a thickness, on the river bank in front of town, of about 30 feet, at the summit of a sub-carboniferous ridge; beyond which the strata are depressed at the Warwick farm to within 20 feet of the river, thence eastwardly they continuously thicken to Independence and the east line of the county, where they show a depth of over 50 feet.

Toward their base, these rocks consist of gray, green, blue and buff shales and shaly sandstones, and are distin-

guished from the knobstones by the occurrence of plates of white chert, as at the foot and sides of the hills east and west of Independence. In the upper division intercalated among the shales are found beds of impure limestone from one to three feet thick, as at low water in front of Williamsport, at the Iron bridge and along the bluff north-east of town, and on Little Pine at Bestana Munson's.

The fossils generally belong to the Keokuk epoch, yet as some of them are equally characteristic of the St. Louis or a later epoch, I have classed the two beds together. These animal remains from different horizons, are promiscuously mingled. We may infer that their habitat was in some adjoining area of clear water; that for short periods the muddy flats which gave origin to the companion shales deposited their sediment and became clear; and that at such periods, these animals introduced themselves, to perish at the next suffusion of impure water. The following list found at Williamsport and Little Pine Creek, exhibits the life of this epoch.

*Archimedes Wortheni*, (spiral axes and lace-like flanges)., *Aulopora*, *Crinoid* stems, plates and spines; stems and plates of *Pentremites* broken or separated, *Productus punctatus*, *P. (cora) tenui-striatus*, *P. semi-reticulatus*. *P. muricatus*, *P. longispinus*, (with spines  $2\frac{1}{2}$  inches long), *Spirifer Keokuk*, *S. textus*, *Athyris ambigua*, *Rhynchonella*, *Bellerophon*, *Nautilus*, *Chonetes* and *Hemipronites crenistria*, with fucoids, probably *Caulerpites*.

#### *Chester Beds.*

Syn. Ferruginous sandstone (Mo. and Tenn.) Mill-stone grit (or *whet-stone* grit. Dr. D. D. Owen).

This formation, No. 27, occupies the stratigraphic position of the Chester limestone of Illinois, but all calcareous material is here absent, as is the case in the more northerly exposures of that State. It consists of yellow or cream-colored, thin bedded sandstone with bands and nodules of clay iron stones; to the north and east of Independence, changing to shales and soft argillaceous sandstone. These



beds are well exposed on Redwood, a short distance above its mouth, and thence west and east underlie the massive sand rock, with a thickness varying from 20 to 44 feet. This is the equivalent to the famous "whetstone grits" in Orange county, and will furnish good sharp whetstones or fine grained grindstones. This stone north of Independence at the Attica quarries, Keeler's quarry, and Jones' quarry on Redwood, is taken up in slabs from two to ten inches in thickness, and may be easily cut or broken into any desired shape. At the last mentioned quarry, the rock is homogeneous and entirely free from iron, and may be readily sawed into door and window caps. This location invites the attention of workers in stone.

No animal remains were found in this deposit, but trunks and leaves of carboniferous plants, as *Lepidodendra*, *Stigmara*, *Cordaite*, and *Calamites*, were seen.

#### CARBONIFEROUS PERIOD.

At the close of the sub-carboniferous period, a bed, No. 26, of dark pyritous clay, containing coal plants, was deposited unconformably and irregularly upon the upper members of that group. On exposure to air it rapidly decomposes, washes away, and gives origin to caves, cascades, and the "rock houses" common in Kentucky and southern Indiana. In the latter region it is often accompanied by a thin seam of coal. Here no coal was found exceeding two inches thick, and a single band of black slate at Munson's old mill on Little Pine.

#### *Conglomerate Sandrock.*

Syn. Millstone Grit—English Geologists.

The Massive Conglomerate, Nos. 24 and 25, lies upon the sub-carboniferous group, and in the surface outcrop, occupies a zone immediately west of the line bounding that formation. In the northwestern part of the county outliers are found capping the highest tables, as at Black Rock and near Milford. It extends westerly with a very slight dip to the west bank of Pine Creek, where the dip to



west and southwest is suddenly increased to the rate of from 20 to 30 feet per mile. Southerly along the line of strike, Pine creek flows in a deep valley, generally walled by bold mural escarpments or overhanging cliffs of massive sandrock, crowned with evergreen pines, cedars and junipers, combining scenery at once grand, wild and beautiful. The valley is from 150 to 200 feet deep, and the narrow margin of alluvial soil was originally crowded with a tangled mass of thorny brush, briars and vines. These features made Pine creek a strong line of defense in Indian warfare, well suited to their strategy, and in the campaign of 1811 the confederated tribes planned to fight here with Harrison's army. The gallant general avoided their ambuscade, and by a quick march to the left flank, crossed higher up, to the open prairie, and ended the war by the brilliant victory at Tippecanoe.

The conglomerate is well developed along both sides of Pine creek, on Kickapoo, at Williamsport, and in the bluffs near the mouth of Redwood creek, a short distance below which, it crosses the Wabash to return in a sharp spur or narrow ridge near the I., B. & W. R. R. "stone cut," northwest from Covington. This formation consists of massive, variously colored sandstone, and rarely presents the typical character from which the name is derived, but near the mouth of Kickapoo, at Black Rock, and at Thompson's quarry near Milford, specimens full of pebbles are found. Generally it is a coarse grained ferruginous or micaceous sandstone, which may be quarried in blocks of any size desired. It may be split or cut freely when fresh from the quarry, but hardens on exposure to the air, and offers, in unlimited quantities, a building material usually fire-proof, and whose capacity for resisting the elements, can be measured by computing the ages required by the river to cut its bed down from the top of Black Rock or Williamsport hill to the present channel, 140 feet below. The stone presents an agreeable variety of colors, varying from a gray or brown on Redwood creek, or gray, yellow and straw color at Williamsport, or white, gray and red, (including

the "bar stripe" and "bleeding stone") on Pine creek, to black, red and yellow, near Milford. When the quality and beauty of this stone is fully investigated, we believe that it will command the attention of railway managers and capitalists.

No animal remains are found in this rock. No signs of life, except the broken and worn trunks of *Lepidodendra*, *Calamites*, and *Sigillaria*.

#### COAL MEASURES.

The coal measures occur next in order of time. They lie directly upon the conglomerate, and in outcrop occupy the regions south and west of that deposit; in area more than one-half the county.

Near the top of the conglomerate, and capped by one of its heavy bedded members, is the horizon of coal A. No. 23 general section. This seam varies from a mere parting, to rolls and balls in local pockets, from one to two feet thick, as at Bizer's on Rock creek. It is not seen in the county of workable extent; but is of practical importance only as a plane from which to compute the relative position of the other coals and strata.

The thick bedded and flaggy sandstones, Nos. 21 and 22, are fine grained, often ferruginous, and at many points quartzose, as if compacted by the breakers of a stormy sea bursting upon a rocky islet or promontory. Here was found the reptilian tracks which Prof. Cox has designated by the name of *Colletosaurus Indianaensis*, Nov. Sp. See plate and description at the end of this county.

No. 20, a bed of black clay shale, with bands and massive boulders of argillaceous and calcareous iron ore is highly carbonaceous, and occupies the horizon of the rich beds of block coal in Clay county, yet it does not offer any distinct seam. It is barren here as it is found to be in Martin, Dubois, and other counties in southern Indiana. Specimens of the iron ore from all the workable outcrops were secured for the State Cabinet; and for analyses of ores from the mouth of Fall creek, Dix's mill, and Cedar bluff, I refer to the chemists' report. These ores are abundant, judging

from the outcrop, rich and mixed with the best ingredients for fluxes, offer a combination of desirable qualities rarely met, and which will at once invite the attention of iron masters when facilities for transportation are secured.

Coal K., with its companion strata, Nos. 16 to 19 of fire clay, black slate, and superincumbent bituminous limestone, succeeds next. These strata, on account of the readiness with which they may be identified, are an important horizon in the geology of Indiana. Their line of outcrop may be traced from near the Ohio river, in Dubois and Pike counties, to the middle of Warren county; and have been recognized by Professor Cox in all the intermediate region almost uninterruptedly. The limestone roof is even more persistent than the coal itself. Consequently, when the coal may be eroded or the conditions such that a true seam was not developed, the place of K. can at once be determined from the occurrence of the lime rock.

K., No. 18, is usually a thick seam of rich, strong, caking coal. As it approaches the margin of the coal basin, it is changed to "semi-block," and at or near the edge of the basin it universally becomes in part, or entirely, block coal—subject to the above mentioned conditions in Warren county the seam is found in the southern parts as in the lower seam on Possum run, at Adamson's, at the Steely farm and at J. Brigg's to be good to choice semi-block, ranging from 2 to  $3\frac{1}{2}$  feet, and averaging 3 1-6 feet thick. On Fall creek at all the banks, seam K. is a choice block coal, free from sulphur, well suited for smelting iron, and with an average thickness of over 3 feet.

No. 16, the dark bituminous limestone roof of K., is almost invariably present, ranging from one to four feet, sometimes changing to a calcareous shale. It is well developed at Mains' mills, on Redwood, where huge blocks are laid bare in the bottom of the creek. Here the stone is highly colored, homogeneous and compact. Specimens have been dressed by workmen. It will receive a high polish, and presents a striking appearance. Locally it is known as "Black Marble." In the lower division of this rock the

following fossils were found, viz: *Spirifer cameratus*, *S. lineatus*, *Athyris subtilita*, *Productus simireticulatus*, *P. cora*, *P. costatus*, *P. longispinus*, *Chonetes variolata*, *Lophopyllum proliferum*, *Pleurotomaria*, *Natica*, *Macrocheilus*, *Phillipsia scitula* (13 in one cluster), Crinoid stems and plates, with teeth and bones of the shark, *Helodus carbonarius*.

The clay shales, No. 15, and ferruginous sandstone, superimposing the "black" limerock, sometimes change into quarry sandstone. This is of no economic importance in this county, which is so well supplied with the conglomerate.

Coal L., No. 13, of general section, offers a greater number of outcrops than any other, and consequently is better known. Presenting the characteristic features seen in other parts of the State, it is a lustrous, laminated, caking coal, rich in carbon, burns to a white ash, and furnishes a first rate fuel for locomotive, rolling mill, or other steam and household use at Briscoe's, Tinkler's, and Harold's mines near Lebanon. At Hooper and Barringer's on Possum run, the product is a good article of block coal, and nearly as good at Luppolds' bank on Fall creek, and in the thin outcrops on Adamson's land, in the extreme southeast corner of the county.

The space between coals L. and M., No. 11, as usual, consists of soapstone and clay shales, changing to argillaceous sandstone. These beds are often crushed and manufactured into potters and terra-cotta ware. The lower member, No. 12, is almost invariably crowded with leaves, fruits, and trunks of carboniferous plants in a remarkable state of preservation. No station in the State can equal in variety and perfection the beautiful specimens found at Briscoe's, West Lebanon shaft, at Tinkler and Harold's near Lebanon, and at I., B. & W. R. R. cut near Covington. The following is a partial list:

*Lepidodendra* (4 sp.), *Ulodendron*, *Sigillaria* (2 sp.), *Stigmara*, *Megaphytum* (?), *Neuropteris* (2 sp.), *Pecopteris* (2 sp.), *Odontopteris*, *Alethopteris*, (2 sp.), *Asterophyllites*

(2 sp.), *Cordaites* (2 sp.), *Hymenophyllites*, with seed spores, *Cardiocarpa*, *Paleoxylon*, and *Sphenophyllum Schlotheimi*.

Coal M., No. 9, of section, is a fat caking coal, containing much sulphur. Outcrops were seen on Mud Pine at Briscoe's, and at Wilson's bank on the head of Fall creek, the product at this point meeting a ready market. The seam ranges from six inches to one and a half feet, and will hardly average sixteen inches thick. The roof of M. generally consists of a black, pyritous slate, lean iron stones, and concretions of argillite, of no economic importance as far as visible in the outcrops. The highest rocks seen in the county are next, No. 6 of section; generally shaley, this bed is of sufficient consistence at a few points to afford quarry rock and grits for grindstones.

The foregoing presents the general geology of the county in a connected view. To this will be added detailed sections—representatives of each neighborhood for local information.

#### LOCAL DETAILS.

Williamsport, the county seat, is situate on the west bank of the Wabash river. Since the construction of the T. W. & W. Ry., the town has extended up and over the bluff to the railway station. A large amount of pork, corn and wheat was shipped from this place, when the early citizens, using "God's free highway," floated their commodities to New Orleans. Considerable shipments are made by rail of live stock, grain, timber and stone. Near the crest of the hill, nearly 100 feet above the river valley, the new court house is seen, trimmed with gray and cream colored conglomerate sandstone, obtained from quarries belonging to Hon. Ben. Gregory and Dr. Boyer, in and adjoining the town; massive in style of architecture, it presents an attractive and commanding appearance. This structure as a demonstrative experiment, showing the quality and appearance of the sandstones which are so abundant in the vicinity, is alone worth its cost. The stone comes from the quarry

soft and easily dressed, hardens on exposure, may be obtained in blocks of the largest size, and could be cheaply quarried and shipped if a railway track was laid to the quarries above or below town. The different strata vary from brown or gray to a delicate straw color. Blocks are thus obtained which contrast in a pleasant but striking manner.

This rock dips to the W. S. W., at about 70 feet, and to the south at the rate of 40 feet per mile. The following section commences near the railway station, and is continued to low water in the river, including the limestone at the iron bridge and the calcareous shales in the lower part of town:

## SECTION AT WILLIAMSPORT.

Soil.....	1 to 4.00
Gravel, loose Sandstone or drift.....	5 to 23.00
Gray shale with iron nodules.....	2.08
Sandstone, flaggy, ferruginous.....	16.00
Bit. shale or coal A.....	.04
Fire clay or Argil. Sandstone.....	2.00
Laminated Quartzose Sandstone.....	8.00
Soft yellow ferruginous Sandstone....	20 to 5.00
Massive conglomerate.....	50.00
Compact ferruginous Sandstone.....	12.00
Blue aluminous shale with <i>Cordaïtes</i> , <i>Calamites</i> , <i>Lepidodendra</i> : highly bituminous and pyritous with partings of coal; place of sub-con glomerate coal .....	5 to 18.00
Covered space.....	7.00
Thin-bedded Argil. Sandstone and "grit" stones, (Chester formation of subcarboniferous group) with <i>Le- pidodendra</i> and <i>Stigmara</i> .....	17.00
Limestone, changing to calcareous sandstone, containing the screw shaped axes and lace-like flanges	



of <i>Archimedes Wortheni</i> , <i>Productus tenuistriatus</i> (cora?), <i>P. muricatus</i> , <i>P. punctatus</i> , <i>P. semireticulatus</i> , <i>Chonetes</i> , <i>Athyris</i> , <i>Hemipronites crenistria</i> , <i>Spirifer Keokuk?</i> <i>Sp. plenus</i> , ? <i>Aulopora</i> , and a <i>Bellerophon</i> sp.?, <i>Rhynchonella?</i> , many <i>Crinoid</i> stems, plates and spines, stems of <i>Pentremites</i> in fragments, and corals.....	2.00
Siliceous shale and soft laminated sandstone, containing <i>Fucoides</i> and <i>Bryozoans</i> .....	5 to 22.00
	<hr/> 188.00

Owing to the rapid dip of strata to the west, this section taken across the tilted edges, and perpendicular to the dip, shows, consequently, a greater thickness than the actual elevation of the hill.

The fossils mentioned in the limestone or calcareous sandstone are sub-carboniferous, and *experience demonstrates that no workable coal seam of economic extent ever has been or may be found below the horizon of the rock containing the fossil Archimedes.*

Near the railway station, Fall branch plunges from the summit of an overhanging mass of rock down sixty feet to the valley, and has thence cut a narrow outlet to the river, affording a first rate section of the conglomerate sandrock in massive strata from twenty to forty feet thick. Here a choice quarry is worked on the land of B. F. Gregory. A large amount of stone is sold, and the business might be greatly increased if better access to the quarry was secured by rail or tram-way. As mentioned in general outlines, it is probable that in the early ages, the Wabash or Pine creek, at a high level, flowed through this gap and thence south. At that time was formed the valley and terrace plain along the railroad, widening southward to Rock creek.



Adjoining town on the south are several localities easily approached by a railway track, where good stone may be quarried at little expense for stripping.

On Dr. Boyer's land S. E.  $\frac{1}{4}$  Sec. 11, T. 21, R. 8, is a small cascade. The water, at the time of my visit, fell in spray or drops. In winter this congealed spray forms fairy grottoes of ice and frost. A spring close by is locally known as the "Sulphur Spring." The ferruginous tufa shows that it is chalybeate. Analyzed by Prof. Cox, (Geol. Ind. 1869, fol. 130), its principle constituents are

Sulphate of protoxid of iron,  
Carbonate of protoxid of iron,  
Bicarbonate of lime,  
Bicarbonate of magnesia,  
Chloride of Sodium (common salt),  
Sulphate of soda, (Glauber salts) small quantity,  
Sulphate of magnesia, (Epsom salts) small quantity,  
Free carbonic acid gas.

The medicinal properties of this will be of value, in cases where iron is indicated. High up on the side of the hill, half a mile south-west from the spring a considerable bed of kidney and banded iron ore was seen. The quantity on the outcrops was considerable, and the deposit merits examination. A specimen was taken for analysis.

Dr. Boyer informs me that he bored three test wells,  $2\frac{1}{2}$  miles west of town, near the line dividing sections 3 and 4, T. 21, R. 8; in one of them near the center of N. E.  $\frac{1}{4}$  Sect. 4, T. 21, R. 9, the workmen reported a seam of splint coal 3 feet thick, at a depth of 81 feet. Three miles west of Williamsport, on S.  $\frac{1}{2}$  N. E.  $\frac{1}{4}$  Sec. 5, T. 21, R. 8, Mr. O. Swank reported 3 feet of coal found in a bore 82 feet below the surface. Spears, Brown & Co., put down test bores on the following lands, viz:

E. Briggs, S. W.  $\frac{1}{4}$  8. 21. 8.

E. Slusser, N. E.  $\frac{1}{4}$  8. 21. 8.

J. Etmyer, N. W.  $\frac{1}{4}$  5. 21. 8.

And reported having found three seams of coal, but none of them thicker than fifteen inches.

The following section was taken on the land of S. B. Mathes, where the Williamsport and Lebanon road crosses Rock creek. The bituminous limestone indicates the place of coal K. The carbonaceous material of the seam is diffused through the black shales below:

*Rock Creek Section.*

S. E. Sec. 18, T. 21, R. 8.

Slope .....	3 ft. 00 in. to 12 ft. 00 in.
Shaly, argillaceous limestone .....	2 ft. 8 in.
Black bituminous limestone containing <i>Spirifer cameratus</i> , <i>S. lineatus</i> . <i>Productus semi-reticulatus</i> , and <i>Chonetes mesoloba</i> .....	4 ft. 6 in.
White clay parting.....	8 in.
Place of coal K:	
Carbonaceous pyritous shale.....	1 ft. 4 in.
Blue Argil. shale.....	1 ft. 2 in.
Black carbonaceous and pyritous shale.....	3 ft. 2 in.
Calcareous iron ore with <i>Spirifer lineatus</i> and <i>Productus costatus</i> ..	6 in.
Dark bituminous shale	2 ft. 8 in.
Impure black sheety slate .....	1 ft. 2 in.
Dark bituminous shale	4 ft. 6 in.
Blue and gray shale.....	17 ft. 00 in.
Light colored shale and soapstone .....	5 ft. 00 in.
Flaggy sandstone.....	15 ft. 00 in.
Coal A.....	2 ft. 00 in. to 00 ft. 2 in.
Fire clay .....	8 in. to 2 ft. 4 in.
	<hr/> 73 ft. 10 in.

The horizon of coal A, is here 55 feet higher than it is found on Dr. Boyer's land south of Williamsport and three miles to the east of this point. The dip there was to the west; here also to the west. These facts show that intermediate a synclinal axis exists. Rolls and sharp waves of such intensity almost forbid hope of workable coal between these points.

On the slope at the top of the section is an old cemetery. Family reasons required the removal of the remains of a woman who had been buried here in the month of March, 24 years ago. The person had died in full flesh. A wet season followed. From the dip of the underlying tenaceous clay and rocks, the grave was kept full of water during the succeeding summer; in fact, one of the assistants expressed his opinion that "the grave would be full of water within three hours after the burial." On opening the coffin, it was found that the body was perfectly preserved, except the upper part of the face, the hands which were crossed *upon* the body, and the upper part of the feet. The body was heavier than in life. The skin was smooth and firm, with a clear transparent whiteness like alabaster. It was generally believed that the corpse had become changed to stone, and a paragraph went through the papers announcing a graveyard full of *Petrified human remains*.

The foregoing phenomenon is explained by the fact that flesh of any animal covered with cool water for several months undergoes a chemical change. First, decomposition commences; ammoniacal gases are formed, which in attempting to escape, are confined near the surface of the flesh or skin by the water. The alkaline gas has affinity for the fatty matter with which it comes in contact, and there is formed ammoniacal soap—*Adipocere*. This substance resembles *spermaceti*, and is not soluble in water.

Another person died in full flesh the same year that this woman died, but was buried during the dry season of autumn. Upon opening this grave for removal, the body was entirely decayed; showing that water was necessary to

produce the seeming wonder. A similar phenomenon occurred in a damp cemetery near Marshfield.

Coal A. has been explored to some extent on David Biser's land, N. E. qr. Sec. 19, T. 21, R. 8. It is deposited in irregular rolls or waves, which vary from 6 to 10 feet from a horizontal line within a space of 300 yards. The pockets of coal are small, and will not be likely to pay for working.

South of Biser's, on land of Mrs. J. Bowlus, W. hf, S. W. qr, Sec. 20, T. 21, R. 8, is a valuable bed of calcareous tufa, which would furnish a considerable amount of good lime. As the lime used in the county is imported, this deposit ought to be utilized.

Near Mains' mill on Redwood, the creek is floored by dark limestone, locally known as "Black Marble." The stone is four feet thick, compact, homogeneous, and is divided into massive blocks by seams running E. N. E. and N. N. W., thus forming huge rhombs. The "marble" is capable of receiving a high polish; it contains some pyrite minutely diffused, and care will be required in selecting stone for the workmen; otherwise it will be liable to tarnish, etc. In a lower member was found *Productus costatus*, *P. cora*, *P. longispinus*, *Spirifer cameratus*, *S. lineatus*, *Athyris subtilita*, *Chonetes mesoloba*, *Macrocheilus fusiformis*, *Natica*, *Lophophyllum proliferum*, palatal teeth of the shark *Helodus carbonarius*, fish bones, Crinoid stems and plates, and a family cluster containing thirteen specimens of *Phillipsia scitula*. The best polished blocks of this marble, I am informed, were obtained from the Hasty land, N. E. qr, N. W. qr. Sec. 35, T. 21, R. 9.

The following section was taken at and below Mains' mill, viz:

#### REDWOOD SECTION.

Slope.....

Black limestone with fossils... 4 to 2 ft. 6 in.

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Black slate.....	2 to	3 ft. 0 in.
Carbonate of iron with <i>Pro-</i> <i>ductus longispinus</i> .....		4 in.
Place of Coal K.....		
Black bituminous slate, with pyritous nodules.....		5 ft. 5 in.
Bituminous limestone.....		9 in.
Quartzose sandstone.....		2 ft. 0 in.
Carbonaceous parting, place of Coal A.....		
Laminated sandstone .....		12 ft. 0 in.
		— —
		26 ft. 0 in.

---

The places of coals A and K are well marked, as at Rock creek section, but the carbonaceous material probably sufficient in quantity if collected together to form seams of workable extent, is here diffused through a space of several feet, and is represented by dark bituminous slate and shales. At other points, as at the mouth of Fall creek on Pine, a similar state of affairs is found; yet within a mile to the west, Coal K of workable thickness and of excellent quality occurs. Hence, we may deduce a *possibility*, if not a probability, that coal K may be found of workable extent, by boring within a mile or two west of these two section stations.

Passing down the creek from Mains' mill we at once notice the rapid rise of strata to the east. The dark limestone and beds marking the place of coal K, mount the sides of the hills at the rate of about 90 feet per mile, and soon pass out at the surface. The underlying conglomerate rises above the level of the creek, and bounds the valley with perpendicular walls of massive sandstone, and at one place its square face was tinted by ferruginous water trickling from above, with brown, red and yellow stripes, rivalling in a small way the "Painted Rocks" of Lake Superior. The conglomerate passes out at the surface, succeeded by the soft laminated sandstones of the upper, or "Chester," beds

of the sub-carboniferous group. The latter, as quarried, may be cut with ease. Experience shows that this stone furnishes good door and window caps. Specimens were seen at Jones' quarry sawed by hand. During the winter and spring months the creek, with appliances, could be made to saw this stone with profit.

On Salts branch, W. H. Goodrick is working a strip bank on N. hf. S. E. qr., N. E. qr., Section 3, T. 20, R. 9. The deposits usually found between coals L and M have here been eroded previous to the deposit of coal M., the erosion thinning to some extent the lower seam.

## SECTION AT GOODRICK'S BANK.

Soap stone with fern leaves.....	1 ft. 2 in.
Black sheety shale.....	5 in.
Black bituminous shale.....	10 in.
Coal M. fat, caking, sulphurous.....	1 ft. 6 in.
Fire clay with stigmatal rootlets...	2 ft. 2 in.
Black clay clod, with "Cone-in-cone" and pyrite.....	1 ft. 3 in.
Coal L.....	
Fair laminated coal ..	1 ft. 5 in.
Good coking coal.....	7 in.
Pure blacksmith coal.	1 ft. 0 in.
Fire clay.....	2 ft. 0 in.
	— —
	11 ft. 6 in.

Tinkler & Co., representing the West Lebanon Coal Co., work the same seam by stripping and by slope on J. Miller's land, W. hf. N. W. qr. Sec. 2, T. 20, R. 9. This coal is reported to give satisfaction wherever used. A quantity was hauled to Lebanon for sale and shipment by rail.

In the S. W. qr. Sec. 2, T. 20, R. 9, a section was taken, commencing on Wm. Salts' land and closing irregularly at the foot of the hill on Geo. Long's land.



## SALTS-LONG SECTION.

Slope .....	
Gray shale.....	6 ft. 0 in.
Black bituminous shale....	0 ft. 7 in.
Coal M.....	1½ ft. to 1 ft. 0 in.
Fire clay with Stigmarial rootlets.....	3 ft. 4 in.
Siliceous shale, yellow .....	1 ft. 4 in.
Soapstone, with iron nod- ules containing <i>zinc blende</i> .....	2 ft. 6 in.
Soft bituminous shale.....	1 ft. 2 in.
Coal L.....	4 in. to 10 in.
Fire clay .....	3 ft. 8 in.
Buff and yellow shale.....	7 ft. 0 in.
Flaggy grindstone grits...	2 ft. 2 in.
Buff shale.....	1 ft. 6 in.
Gritty sandstone and cov- ered .....	17 ft. 0 in.
Black limestone at Long's residence .....	3 ft. 0 in.
Blue and black shale.....	7 ft. 0 in.
Coal K, reported <i>block</i> .....	1 ft. 6 in.
Fire clay.....	3 ft. 0 in.
	— —
	62 ft. 7 in.

Coal was formerly mined by stripping in N. E. qr., Sec. 10, T. 20, R. 9, known as the "Steely farm," and on lands owned by Salts, Long, Briggs, Miller and Fields, for a space of about three-fourths of a mile along the river bluff. The coal was supplied to steamboats on the river. The seam ranged from one and a half to two feet thick. The banks were not in work. The fragments seen were fair to a good article of block coal.

In N. E. qr. N. E. qr. Sec. 9, T. 20, R. 9, on the land of Levi Cronkhite, Messrs. Harrell, Cronkhite and Garrison, known as the Marshfield Coal Co., are working coal L by stripping on a sufficient scale to supply the large local trade



Their coal is a splendid article, bright, lustrous, free from dust, and burns to a white ash. Fragments were seen almost as pure and resinous as the Nova Scotian *Albertite*. Their location gives the following section, viz.:

## MARSHFIELD COAL CO.'S SECTION.

Slope—Fluviatil and glacial drift.....	95 ft. 00 in.
Coal M—not worked.....	1 ft. 8 in.
Fire clay.....	2 ft. 6 in.
Soapstone.....	2 ft. 4 in.
Soapstone, Fern bed containing <i>Cordaites</i> (2sp.), <i>Calamites</i> , fern stems, <i>Pecopteris</i> (2sp.), <i>Neuropteris hirsuta</i> , <i>N. rarinervis</i> , <i>N. Collinsii</i> , <i>Annularia longifolia</i> and <i>Sphenophyllum Schlotheimii</i> .....	1 ft. 8 in.
Dark soapstone.....	2 ft. 00 in.
Carbonaceous clod—imperfect coal.....	1 ft. 1 in.
Coal L.....	
Caking coal..... 7 in.	} 2 ft. 8 in.
Laminated coal..... 9 in.	
Fat resinous coal..... 1 ft. 4 in.	
Fire clay .....	4 ft. 0 in.
	— —
	113 ft. 0 in.

This locality may be noted for the abundance, singular perfection and beauty of the plants found in the "fern bed." Specimens of *Neuropteris hirsuta* four to six inches long, were seen, with the small lobes at the base of frond, attached; also flattened trunks of *Calamites* and ribbed leaves of *Cordaites borassifolia*, ornamented with the delicate

*Gyromices ammonis*, described by Professor Lesquereux in Geology of Illinois vol. II.

On Coal branch a short distance southeast from the Marshfield mine, Claypool works coal L by stripping. The product is a good caking coal, which burns to a white ash. The seam is two and a half to three feet thick, with outcrops similar to the foregoing section. Descending the branch, the seam dips to the east, nearly to the bluff line, with the fall of the brook. The dip is then reversed. Throughout the intervening space the seam may be traced, and a careful observer will notice that the coal was deposited in waves or rolls, from 50 to 150 feet in width, thickening well up at the centers of depression, but thinning to a thread at the wave crests or horse backs. Mr. Claypool has driven entries into several of these small wave pockets without satisfactory results. Features similar to those above mentioned are observed at Cannelton, Perry county\* and north of Briscoe's mine on Mud Pine.

On Possum run, Section 8, T. 20, R. 9, Hooper and Barringer, of Danville, Illinois, noticed the presence of "block coal" in "prospecting." They secured control over a sufficient territory, and at once thoroughly explored their property by boring twenty-five (25) test wells. Finding coal from two, to three feet two inches thick in each, of their wells (except three, which were located on the west side of the brook), they proceeded to put down a shaft close by the track of Indiana division of the C. D. & V. railroad. At a depth of 25 feet coal L was found of workable thickness, and thirty-four feet below L, coal K was met, having a depth of three feet two inches. I am indebted to Mr. Hooper for the following statements of strata at shaft, viz:

HOOPER & BARRINGER'S SHAFT AND BORE.

*Possum Run N. E. qr., Sec. 8, T. 20, R. 9.*

Soil.....	3 ft. 0 in.
Yellow clay, with float coal.....	9 ft. 0 in.

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\* Lesly's Manual.

Soapstone, changing to argil. sandstone.....	12 ft. 6 in.
Soapstone, Fern bed containing <i>Lepidodendra</i> (bark and leaves), <i>Calamites</i> , <i>Sigillaria reniformis</i> , <i>Annularia longifolia</i> , <i>Asterophyllites equisetiformis</i> , <i>Sphenophyllum Schlotheimii</i> , <i>Pecopteris</i> , and <i>Cor- daites borassifolia</i> .....	2 in to 6 in.
Coal L, block.....	2 to 2 ft. 8 in.
Fire clay.....	3 ft. 6 in.
Rock in bore.....	25 ft. 3 in.
Hard limestone.....	3 ft. 0 in.
Coal K.....	3 ft. 2 in.
Fire clay.....	2 ft. 4 in.
	<hr/>
	64 ft. 7 in.

Owing to circumstances I did not pass down the shaft. A quantity of coal at the dump showed that the product of L here contained but a small amount of sulphur, and was good block coal well suited for smelting iron. The sulphur is mostly gathered in a small parting one foot above the bottom of the seam, and may be separated in mining. The coal is very compact in its lower division, but laminated and softer at the top. It burns to a white ash. The seam is divided into cubes one and a half to two feet square, with clay and lime whitewash in the partings, as in Clay county. It may be mined in large blocks. Mr. Barringer informs me that from the bottom of the shaft an entry has been driven to northeast 150 feet, the coal holding an average thickness of three (3) feet. Within that distance two "horse backs" (wave crests) were passed, but so close together that they may be held as parts of one—both not occupying more than 45 feet; the first was three feet and the second thirteen feet wide, with an intervening space of twelve feet. Mr. Barringer reports that the coal throughout the whole extent of their work, presents a quality of block coal fully equal to the product seen at the dump. An average specimen

was secured for analysis (see chemist's report), and exhibition in the State Cabinet.

The fire clay in the shaft is buff or gray, plastic, and after exposure to the atmosphere will prove suited to the manufacture of pottery, tiles and terra cotta wares. The clay has been shipped to Chicago for trial, but I am not informed as to the results.

I was informed that a shaft was put down on Mr. John Gilman's farm, S. E. qr., Sec. 8, T. 20, R. 9, adjoining Hooper & Barringer, on the west side of Possum run, to coal L. I did not learn the result.

On Adamson's farm, S. E. qr. Sec. 27; T. 20, R. 9, is a mass of conglomerate sandrock, forming the bluff of the river, eminently characteristic of that stone. Quarried, it has been used for bridge piers, fire-walls, and for hearth-stones at Indiana Furnace at Clinton. This deposit is the termination of a sharply angular spur, boldly piercing the coal basin from the old conglomerate hills which then existed east of the Wabash. Cross-currents swept this headland, and deposited wedge-shaped layers on each side with some carbonaceous matter. This process was repeated; more wedge shaped plates were deposited, rounding the sharp apex into a flattened dome, where we find coal K. A bed of laminated argillaceous sandstone follows, and then coal L is arched over the hill. A similar phenomenon occurs on Mud Pine, north of Briscoe's bank, and at the west end of Dix's mill dam, on Big Pine. In the adjoining cut of the I., B. & W. R'y, were found fine specimens of ferns, plants and fruits of coal measure epoch.

#### SECTION AT ADAMSON'S COAL DOME.

Soil and gravel.....	2 ft. 00 in. to 10 ft. 00 in.
Fine laminated sandstone	
argil .....	10 ft. 00 in.
Soapstone and gray shales	
with ferns.....	6 ft. 00 in. to 00 ft. 8 in.

Coal L? semi-block.....	1 ft. 10 in.
Fire clay, <i>roots and stumps</i> of <i>Stigmara</i> .....	3 ft. 6 in.
Heavy bedded—slightly wedged, and flaggy sandstone.....	29 ft. 00 in.
Calcareous, ferruginous band.....	6 in. to 1 ft. 3 in.
Coal K? .....	6 in. to 1 ft. 2 in.
Fire clay.....	2 in. to 4 ft. 00 in.
Beds of wedge shaped sandstone with carbon- aceous partings.....	20 ft. 00 in.
Massive conglomerate.....	15 ft. 00 in. to 9 ft. 00 in.
	— —
	90 ft. 5 in.

The crown of this coal measure hill has been partially eroded by drift action, and upper spaces are measured at lower levels in I. B. & W. railway stone cut. The spring of these arched strata will measure about 20 feet in a chord of 500 feet.

No outcrops are visible near State Line City, or at Marshfield. The intervening region consists of undulating prairie, with skirts and heavy bands of oak, sugar and other forest trees to the east. A fine growth of walnut was noticed at Gopher Hill, the farm of Perrin Kent, Esq.

West Lebanon is a thriving village situated on the line of the T. W. & W. railway at the crossing of the proposed railroad thence north to Michigan City. It is surrounded by fertile and productive lands. A well, bored for water in the western part of town, discovered at a depth of 150 feet a seam of coal having a reported thickness of three feet. The citizens formed a mining company, and sunk a shaft to a depth 149 feet, passing through two seams of coal and by bore demonstrated the existence of a third seam at a total depth of 183 feet. I am indebted to Joseph Bauer, superintendant, for the following stratigraphic report.

## SECTION IN WEST LEBANON SHAFT.

Soil and clay.....	20 ft.	0 in.
White, yellow and black sand pocketed in clay, with sandstone fragments.....	12 ft.	6 in.
Glacial blue clay and gravel.....	17 ft.	0 in.
Dark clay, with sandstone and large granite boulders.....	25 ft.	0 in.
Blue and green clay with pebbles.....	14 ft.	0 in.
Black mould—roots of trees in <i>situ</i> ,	0 ft.	2 in.
Dark clay and mucky soil filled with large limbs and roots of trees, apparently birch or pine.....	15 ft.	0 in.
Disturbed sandstone, with decomposed nodules of pyrites.....	6 ft.	0 in.
Coal M. Caking—pyritous—		
Coal.....	0 ft.	8 in.
Parting.....	0 ft.	4 in.
Coal.....	0 ft.	8 in.
— —	1 ft.	6 in.
White clay and soapstones.....	1 ft.	8 in.
Soapstone containing <i>Lepidodendron clypeatum</i> , <i>L. arculeatum</i> , <i>L.</i> (2 sp.?) Leaves of do., <i>Lepidostrobus</i> , <i>Sigillaria reniformis</i> , <i>S.</i> (sp?) <i>Ulodendron punctatum</i> , <i>Sphenophyllum Schlotheimii</i> , <i>S.</i> (sp?), Fronds of <i>Pecopteris</i> , <i>Alethopteris</i> , <i>Cordaites borassifolia</i> , and <i>Hymenophyllites spinosus</i> ....	5 ft.	2 in.
Coal L. Semi-caking.		
Coal.....	1 ft.	0 in.
Clay parting.....	0 ft.	10 in.
Coal.....	1 ft.	0 in.—2 ft. 10 in.
— —		
	149 ft.	10 in.



## Bore:

Fire Clay.....	5 ft. 0 in.
Blue shale.....	6 ft. 0 in.
Dark limestone, effervescing in acid.....	7 ft. 0 in.
Black slate.....	5 ft. 8 in.

## Coal K.

Pyritous coal.....	0 ft. 9 in.
Pyrite parting.....	0 ft. 5 in.
Coal .....	0 ft. 5 in.
Carbonaceous concretion	2 ft. 0 in.
Fire clay.....	2 ft. 0 in.
Sandstone.....	4 ft. 0 in.—33 ft. 3 in.

— —  
183 ft. 1 in.

The partings and concretions found in these coals, rather indicate that the well was bored through a series of "horse backs," which are often known to preserve a perpendicular line through a series of coals. The truth as to this can only be known by additional bores, or by driving entries, not less than seventy feet, sidewise, or against the sides of the cubes of coal.

The fossil plants were abundant, well preserved, and an interesting chapter of nature's history of the past. The fronds of *Hymenophyllites* were tipped with just ripening seed spores. Many fern stems were seen from two to three inches in flattened diameter.

In the Indian Reserve, one mile east of Williamsport, Mr. Jordan has two quarries worked in the thin bedded argillaceous sandstones of the Chester formation, where the following section was taken, viz :

Shale and sandstone, slope.....	20 ft. 00 in.
Limestone with Keokuk and St.	
Louis fossils.....	2 ft. 00 in.
Thin bedded, quarry sandstone.....	10 ft. 00 in.

— —  
32 ft. 00



John R. Keeler works the "Attica quarry," southwest quarter, section 31, township 22, range 7; a thin bedded Chester sandstone. The strata thicken toward the bottom to beds of two feet. Good whetstones and finishing grindstones have been obtained here. Much building stone is quarried and sold.

On the north side of Pine creek, in the river bluff, is a deposit of the same formation, worked by Peter Hickman, with expose as follows:

HICKMAN'S QUARRY, SECTION.

Clay and soil.....	4 ft. 00 in.
Sandstone in bands of 1 to 2 feet, parted by 2 in. to 4 in. of clay shale..	10 ft. 00 in.
Heavy bedded yellow sandstone, strata 2 to 4 ft.....	15 ft. 00 in.
	— —
	29 ft. 00 in.

These lower beds are yellow colored, ferruginous, and the product bears a good reputation. It is used for piers and heavy masonry. In all these quarries the blue colored strata are argillaceous, and on exposure, liable to wear. An unlimited quantity of good stone may be selected from the enduring beds.

A short distance east from Hickman's quarry, the subcarboniferous rocks are sunk below the surface by a synclinal valley filled with conglomerate sandstone, which reaches down near the base of the hills along the bluff road.

On Mrs. Warwick's land Sec. ?, T. 22, R. 7, a small brook has worn a narrow chasm through the conglomerate, down to the shales below. The small stream descending a rapidly inclined plane, or leaping from strata of harder rock, flecks the dark recess of the chasm with a silvery sheet of water and foam. On the summit, ancient pines seem to wave their sombre plumage against the blue sky, and cast down their cones as an offering to the fay of the fountain.

The following section was observed, viz:

## WARWICK CASCADE SECTION.

Incline.....	
Thin bedded conglomerate, with	
pebbles .....	10 ft. 00 in.
Massive congl. irregularly bedded...	40 ft. 00 in.
Dark bituminous shale with leaves,	
stems and trunks of coal plants...	10 ft. 00 in.
Blue and gray sub. carb. shale.....	20 ft. 00 in.
	— —
	80 ft. 00 in.

A short distance east of the Warwick Cascade, and about two hundred and fifty yards west of Kickapoo mills, the subcarboniferous rocks again rise above the level of the bottom's road. Here the concretionary nature, often characteristic of the Chester beds, is exhibited in a highly interesting manner. A perpendicular wall of thin bedded sandstone guards the north side of the road. From the escarped face great spherical balls are projected in relief, four and a half to five feet in diameter. A similar phenomenon was observed in the same formation on Redwood creek.

For a distance of from two to three miles from the Wabash in the valleys of Pine creek, Kickapoo and Little Pine, good exposures of the Chester sandstones are seen changing toward the north, to silicious and then to argillaceous shales or mudstones; at a few points nodules of iron ore and small quantities of zinc blende are present.

## SECTION ON PINE CREEK.

*S. W. Quarter, Section 26, Township 22. Range 8.*

Drift.....	40 ft. 0 in.
Conglomerate, quartzose sandstone...	2 ft. 6 in.
Shale, and bands of Chester sandstone..	19 ft. 0 in.
Thin bedded argil. Chester sandstone..	19 ft. 0 in.
Ferruginous argil. sandstone with	
geodes containing zinc blende...	8 ft. 0 in.
Blue shale to Pine creek.....	3 ft. 0 in.
	— —
	82 ft. 0 in.

At Gold branch of Pine creek, N. W. qr. Sec. 23, T. 22, R. 8, on a gravel bar formed of debris washed from the boulder drift, a quantity of gold, reported at \$70, was collected. An energetic Californian can "pan out" from \$1 to \$1.25 per day at this, and several other gravel bars in the county. An equal amount of labor expended at any ordinary avocation, will bring better returns.

Independence is situated on the summit of a ridge or roll of Chester rocks, and the rapid dip of underlying strata, draining the porous soil resting upon them, causes an outflow of many strong springs. These rocks were once capped with outliers or regular beds of conglomerate. The latter was eroded by force of fluvial or glacial currents. The resulting debris formed the terrace plain or "barrens" which surround the village for a space to west or southwest of one or two miles. Beyond this plain on Kickapoo and Pine Creek, the sandrock develops massive blocks and cliffs of good stone. On the hillsides, near Independence, bands of white chert occur, intercalating beds of sandstone and clay, and a heavy development of chert is reported across the river at Flint creek. At the road crossing, a short distance above the mouth of Little Pine creek, is an exposure ninety-eight feet thick, of blue arenaceous shales. In appearance they much resemble the Knobstone beds. No fossils were found. The stratigraphic position, and an underlying bed of chert and geodes, will, I think, justify the classification of this bed with the upper or middle member of the sub carboniferous group.

Black Rock, southwest qr. Section 9, T. 22, R. 6. is a notable and romantic feature in the river scenery. A precipitous or overhanging cliff exhibits an almost sheer descent of 140 feet to the Wabash at its foot. The top is composed of yellow, red, brown or black conglomerate sandrock, highly ferruginous, and in part pebbly. At the base of the sand rock where it joins upon the underlying carbonaceous and pyritous shales are, "pot" or "rock houses," which so constantly accompany this formation in southern Indiana. Some of these of no great height have

been tunneled back under the cliff to a distance of 30 or 40 feet, by force of the ancient river once flowing at this level.

## SECTION AT BLACK ROCK.

Conglomerate .....	40 ft. 00 in.
Bituminous shale.....	12 ft. 00 in.
Blue and green argillaceous shale and soft sandstone, Chester, St. Louis, and Keokuk.....	83 ft. 00 in.
Knobstone shale.....	5 ft. 00 in.
	— —
	140 ft. 00 in.

From the top of this hill may be enjoyed a fine view, comprising the river winding through the beautiful valley to the southwest, eastwardly the Wea plains are checkered with fields of grain and grass, while frequent trains on the railroad play "hide and seek" in clumps of timber skirt-ing the valley, and give life to the landscape.

Going north towards Milford, outliers, of conglomerate cover the tops of the hills and the table lands (beneath the surface deposits), while the deeper valleys present good exposures of the sub-carboniferous group.

At Bee run, on lands belonging to Chauncey's heirs, east half s. w. qr. Section 4; T. 22; R. 6, a party of strangers with a great air of mystery, made an extensive trench up the face of the bluff to the base of the conglomerate. The material cast forth showed that they had dug a few feet into the bituminous and the blue shale which lies just below the sand rock. This level is exposed at a dozen points on Bee run and Little Pine. No minerals were found; the explorers certainly had barren results.

At W. Gooden's tract, west half northeast quarter Section 4; T. 22; R. 6, near Tippecanoe county line, the following outcrop is seen :

## GOODEN'S CASCADE SECTION.

Slope.....	
Conglomerate—pebbly, overhanging or cavernous, containing <i>Lepido-</i> <i>dendra</i> , <i>Calamites</i> and <i>Cordaietes</i> ..	25 ft. 00 in.
(Rock house shed,).....	
Carbonaceous shale.....	2 ft. 00 in.
Sub-carboniferous shale, blue.....	20 ft. 00 in.
	— —
	47 ft. 00 in.

Bones of men and animals found under the overhanging roof-rock, in a bed of ashes and calcareous tufa, showed that this rock house had once been inhabited. In the gorge below, beautiful ferns of many species were noticed, including quite a plat of the climbing fern, *Lygodium palmatum*.

At Sinaway Munson's old mill-seat, on Little Pine creek, is a thin bed of bituminous slate, with minute pockets of coal. There is no probability of finding a workable seam here.

## MUNSON'S MILL SECTION.

Slope.....	
Quartzose conglomerate resting on pebbly base.....	4 ft. 00 in.
Carbonaceous and black sheety shale	1 ft. 8 in.
Quartzose and green shales with Spi- rifers and Bryozoans.....	20 ft. 0 $\frac{1}{2}$ in.
	— —
	30 ft. 2 in.

Ascending the creek on the south part of Bestana Munson's farm, S. E.  $\frac{1}{4}$  Sec. 5, T. 22, R. 6, a calcareous sandstone, containing a few characteristic sub-carboniferous fossils, as *Nautili*, *Sperifera*, (3 Sp.), *Allorisma*, *Athyris*, *Producta* (2 Sp.), an indistinct *Crinoid*, and *Calamites*, *Cordaites* and *Fucoides*, underlaid by a thin bed of small geodes.

In the N. E.  $\frac{1}{4}$  of Sec. No. 5, at the eastern bluff of the creek, the following was secured, viz :

## SECTION ON LITTLE PINE CREEK.

*Bestana Munson's land.*

Slope, with conglomerate Sandstone..	20 ft. 00 in.
Blue and buff colored Shales, with <i>Cordaites</i> .....	45 ft. 00 in.
Impure limestone, with a few <i>Arch- imidean Bryozoa</i> , <i>Producta</i> , and <i>Spirifers</i> .....	4 ft. 2 in.
Pink and greenish shale, with <i>Nau- tilus trematodiscus</i> .....	3 ft. 6 in.
Yellow Keokuk limestone, <i>Productus</i> , with spines 2 to 5 in. long, <i>Hemi- pronites crenistria</i> and <i>Spirifers</i> .....	1 ft. 2 in.
Soapstone and blue shale.....	16 ft. 0 in.
Band of Argil. iron ore, (lean).....	0 ft. 8 in.
Shale, with small geodes.....	2 ft. 6 in.
Argil. iron ore (lean).....	1 ft. 0 in.
Blue shale.....	4 ft. 0 in.
	— —
	98 ft. 00 in.

A slab covered with *Producta* showed *spines* of remarkable length and tenuity. Many of the fossils were partly geodised. The *Nautilus (Trematodiscus) digonus*, is believed to be of lower Knobstone type, like those found in the Goniatite bed at Rockford, Indiana.

"Falling rock cascade" is situated in the E.  $\frac{1}{2}$  S. E.  $\frac{1}{4}$  Sec. 6, T. 22, R. 6, on land belonging to Orren Munson. A sheet of cold spring water, from the exposed top of the conglomerate, leaps 35 feet down to the bottom of a narrow chasm cut out by the brook. The precipitous and overhanging sides are fringed with long pendant masses of stalactitic or mossy tufa. Pine trees around the rim, make perpetual shade in this cool grotto. It is a favorite resort for pic-nic parties, and for the "basket meetings" of the United Brethren Church. The calcareous tufa, burned, would furnish a large amount of good lime. Quantities



broken from ancient points of deposit, were seen lower down the ravine.

#### SECTION AT FALLING ROCK CASCADE.

Conglomerate Sandstone.....	15 ft. 00 in.
Sub-carboniferous shales and soft sandstone, with <i>Cordaites</i> , leaves of <i>Lepidodendra</i> , and <i>Neuropteris</i> . ...	25 ft. 00 in.
Same, with iron nodules of large size and fair quality.....	5 ft. 00 in.
	— —
	45 ft. 00 in.

Milford is situated upon elevated table land, and presents an air of thrifty life. Here is located "Green Hill Seminary," under charge of the church of the Brethren. One and a half miles south-west of the village, is an easily accessible quarry of conglomerate sandstone on the land of J. B. Foster, N. W.  $\frac{1}{4}$  Sec. 32, and G. W. Thompson, N. E.  $\frac{1}{4}$  Sec. 31, both in township 23, N. R. 6; small beds of pebbles in bands are seen in the upper layers, with sporadic pebbles throughout. This stone when quarried is soft, apparently disintegrating, but on exposure hardens and becomes almost as compact as limestone. Even fresh from the quarry, as tested, will bear the burden of bridge piers and heavy structures and may be obtained in blocks of as large size as can be managed. The exposure is continuous for half a mile along Schoolhouse branch, exhibiting a wonderful variety of bright colors, as red, brown, black, yellow, and gray; the more vivid colors predominating. Several layers are beautifully striped, the result of false bedding, by straight, clean cut red lines crossing the plane of deposition at angles of  $30^{\circ}$  to  $45^{\circ}$ . The stone has been tested for foundations, back-walls and hearth-stones, and, I am informed, is found to be fire and weather-proof.

The following section was taken at Geo. W. Thompson's quarry, and thence along the road, leading south to the top of the hill:

## RED AND STRIPED SANDSTONE QUARRY SECTION.

Red sandstone, heavy bedded	52 ft. 00 in.
Covered .....	4 ft. 00 in.
Soft, gray sandstone ..... 3 ft. to	2 ft. 00 in.
Brown sandstone.....	3 ft. 00 in.
Banded pebbles.....	3 in.
Red sandstone.....	5 ft. 00 in.
Brown and striped sandstone	3 ft. 6 in.
Yellow ferruginous sand-	
stone .....	4 ft. 00 in.
	— —
	73 ft. 9 in.

It is believed this quarry will invite the attention of dealers in ornamental stone for heavy masonry.

Passing the splendid grazing grounds and well selected and fattened herds of James Mather, we find Pond Grove situated well in the northeastern corner of the county. Near the center of this grove was a body of water known as "Cranberry Pond." The lakelet was surrounded at the shallow outskirts by a natural growth of cranberry plants, including the "long vine," which bears oblong berries, and the "short vine," which bears sphere-shaped berries. Good crops followed a wet June, or the reverse. The maximum crop, in a favorable year without any care or attention, I am informed by Mr. T. D. Chenoweth, would measure not less than seventy bushels, ranging down to ten bushels per acre. About two hundred acres were formerly in productive vines. The pond is now drained. Berries are no longer produced. This is a public calamity, as a crop of berries, worth from \$50 to \$300 per acre, yields a greater income than may be realized from any other production. In places like this and others in the vicinity of Pine village, naturally suited to the growth of the vine, its cultivation in a systematic manner, would certainly offer better returns than are realized from the expensive plantations made on the high priced lands of Rhode Island and Massachusetts.

Pine village is surrounded by a large area of level or gently rolling prairie. The well appointed grounds of the "Grand Prairie joint-stock Agricultural Society" are located adjoining the village. At the time of my visit, the County Fair was in progress. The live stock, especially swine and cattle, and other products, would compare favorably with those exhibited at any county fair in the State. Comfortable residences, neatly kept farms, were significant and characteristic of this vicinity. From Dr. Peter's report (Owen's Geol. Ind., 1859,) I copy the following tabulated analysis of soils from Wagner's Grove, Sec. 14, T. 23, R. 7.

	No. 19.—Virgin soil in Grove.	No. 20.—Prairie soil in old field.	No. 21.—Bottom prairie soil.	No. 22.—Subsoil at 1 foot.	No. 23.—Subsoil at 2 feet.	No. 24.—Subsoil at 3 feet.
Organic and volatile matters.....	1.266	0.983	1.127	0.800	0.500	0.550
Alumina and Oxides of Iron, Manganese and Phosphates.....	.603	.323	.090	.247	.073	.130
Carbonate of lime.....	1.793	1.477	1.610	.641	.410	1.127
Magnesia.....	.380	.383	.321	.144	.100	.227
Sulphuric acid.....	.079	.113	.107	.104	.129	.068
Potash .....	.064	.147	.109	.145	.177	.060
Soda .....	.122	.132	.209	.187	.037	.161
Silica .....	.380	.420	.337	.330	.247	.347
Loss .....	.....	.....	.307	.....	.227	.....
Extract, dried at 212° F., grains.....	4.687	3.978	4.217	2.598	1.900	2.670

The *chemical composition* of these soils, dried at 440° F., is represented as follows :

	No. 19.—Virgin soil, grove near prairie.	No. 20.—Prairie soil, rising ground, old field	No. 21.—Prairie soil, bottom.	No. 22.—Prairie sub- soil at 1 foot.	No. 23.—Prairie sub- soil at 2 feet.	No. 24.—Prairie sub- soil at 3 feet.
Organic and volatile matters.....	8.286	5.473	8.851	2.805	2.654	2.931
Alumina.....	2.010	2.610	4.335	1.810	2.460	2.985
Oxide of iron.....	3.365	2.740	3.315	2.150	3.765	4.540
Carbonate of lime.....	.945	.645	1.545	.270	.395	.895
Magnesia.....	.753	.795	.878	.519	.599	.901
Brown oxide of manganese.....	.215	.115	.190	.090	.215	.190
Phosphoric acid.....	.255	.198	.237	.194	.161	.214
Sulphuric acid.....	.153	.100	.127	.062	.084	.050
Potash.....	.256	.125	.309	.235	.272	.360
Soda.....	.038	.....	.068	.041	.036	.056
Sand and insoluble silicates.....	82.615	86.565	80.515	91.490	88.065	86.066
Loss.....	1.109	.634	.....	.334	1.294	.812
Total.....	100.000	100.000	100.388	100.000	100.000	100.000
Moisture expelled at 400° F.....	7.375	5.000	7.075	2.850	2.975	4.475

I may quote Professor Owen's conclusions :—

“The essential mineral elements of vegetable nourishment being abundant, with plenty of organic matter to aid in their solution, these soils ought to be quite productive.”

Specimens of bog iron ore are found near Pine village. The quality is good. Extensive beds are not known.

At Rainsville good exposures of the conglomerate sandstone occur. Thence south this formation underlies or forms all the bluffs on the east side of the stream to a point below the mouth of Fall creek. Generally it is seen also in the bluffs on the west side; the strata dipping to W. or S. S. W. The central trend of the creek valley follows the line of strike. The disintegrating material at the horizon of coal

A, seems to have been the initial inducement that gave direction to the creek.

Outcrops of colored conglomerates are noted near the mouth of Mud Pine. Jacob Beisel works a quarry N. E. qr. Sec. 29, T. 23, R. 8. The product was used for piers at the bridge higher up the stream. The stone lies nearly horizontal. It is striped with diagonal red lines traversing the strata, at angles of from  $10^{\circ}$  to  $30^{\circ}$ , called false bedding. These highly colored stones indicate material covered soon after deposit, buried before the surf and waves had time to purify the material by washing, (Dawson's Earth and Man). The diagonals here, at Milford and at Williamsport face to W. S. W., and for their origin demand a sedimentary stream from E. N. E., and a broad, deep, wave-tossed sea\* to W. S. W.

On Beisels' land, one-fourth mile to the west, is a remarkable quarry of sandrock, showing an outcrop of 15 feet, in beds one to two feet thick. This stone may be broken or split to blocks or slabs of any desired size. Weathered exposures present a grayish white color; but when being dressed fresh from the quarry, every stroke of pick or chisel develops a faint show of vermilion or carmine. The sensitiveness to blow or cut has given this stratum the name of "Bleeding Stone." The color arises from thread-like diagonals of oxide of iron. The product of this quarry bears an excellent reputation for endurance. It forms the piers at Rainsville bridge. On the same tract a bed of impure caking coal occurs. Only weathered fragments were visible.

At Jno. T. Briscoe's bank, worked by W. R. Hardesty, the following section was taken, extending along Mud Pine across the dip, viz:

#### SECTION AT BRISCOE'S COAL MINE.

*S. E. Quarter, N. W. Quarter, Sec. 29, T. 23, R. 8.*

Drift and soil..... 20 ft. 00 in. to 10 ft. 00 in.

Grindstone grits and

yellow sandstone...

10 ft. 00 in.

---

\*For further discussion, see authority cited.

Slate and iron stones. 3 ft. 00 in. to 1 ft. 2 in.

**COAL M—impure-**

caking..... 2 ft. 00 in. to 1 ft. 4 in.

Fire clay..... 3 ft. 00 in.

Covered..... 5 ft. 00 in. to 1 ft. 00 in.

Soapstone and argil-  
laceous sandstone.. 6 ft. 00 in.

Soapstone; Fernbed,  
containing leaves  
of *Lepidodendra*,  
*Cardiocarpum in-*  
*gens*, *Cordaites bo-*  
*rassifolia*, *Neuro-*  
*pteris rarinervis*, *N.*  
*hirsuta*, *Odontop-*  
*teris* (Sp?), *Pecop-*  
*teris arborescens*, *P.*  
(Sp), *Alethopteris*  
*Serlii*, *A. lonchitica*  
*Sphenophyllum*  
*Schlottheimi*, *Astero-*  
*phyllites equi-seti-*  
*formis*, and *Annu-*  
*larie* ..... 1 ft. 00 in. to 2 ft. 00 in.

**COAL L.**

Laminated coal good	00 ft. 4 in.	}	2 ft. 6 in.
Choice blacksmith			
coal.....	1 ft. 6 in.		
Laminated coal.....	00 ft. 6 in.		

Black and gray slate,  
with leaves of *Sig-*  
*illaria*..... 1 ft. 6 in.

Impure, irregular  
coal, (K?)..... 10 in. to 1 ft. 4 in.

Fire clay, to water... 3 ft. 6 in.

— —  
43 ft. 4 in.



At outcrops of underlying strata in the bed of the creek, no showing of coal or accompanying strata were seen lower than the bottom of this section, and the existence of a workable bed below, while possible, is highly improbable.

Briscoe's bank yields a compact, clean, lustrous semi-caking coal, which burns to a white ash. Locally it is esteemed as a steam, household or smith coal. It is well suited for locomotive or rolling mill purposes, and with the addition of less than one-half coke may be used for smelting iron. The "fern bed" presents an attractive variety of well preserved plants, characteristic of the roof shales of Coal L.

Outcrops of coal about 2 feet thick are reported on adjoining lands, S. W.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  Sec. 29, T. 23, R. 8. At the mine the worked seam dips N. W. at about 60 feet per mile. This is probably only a local wave. Ascending the stream, the upper coal is scattered in pockets at the crest of *rolls* or *waves*, from 4 to 7 feet high, and with a space of from seventy to one hundred and fifty feet between. A sectional cut would be necessary to convey a correct idea of this interesting feature. I can only account for this phenomenon, by referring it to a rush and return of successive tidal waves "boring" a narrow arm of the ancient ocean.

Spaces between the pockets diminish as we proceed north. On John Steeley's land, N. E.  $\frac{1}{4}$  Sec. 19, T. 23, R. 8, an outcrop coal, heretofore reported as four feet thick, occurs.

A Lafayette mining company commenced on this, and drove a horizontal entry 126 feet on the seam in a W. N. W. course, which resulted in demonstrating that the features so plainly seen in the outcrop, continued under the hill. Dr. James C. Deming informs me that the entry crossed five of these wave lines nearly at right angles. He found the rolls from 6 to 12 feet apart. The "pockets" of coal were flattened cylinders or elongated trapeziums, crushed when in a plastic state, from one to three feet thick, and connected by a parting or thread of carbonaceous matter. The coal was mostly impure and worthless; although some bright and lustrous lumps were found. This disastrous experiment

was abandoned. Heavy bands of siliceous ores of iron were noticed along the bed of Mud Pine, between Steeley's and Briscoe's, containing *Spirifera*, *Producta*, and a few other coal measure fossils.

At "Cedar Bluff," on Pine creek, the ancient conglomerate bluff faced west, and sloped in that direction with an incline of from three hundred to five hundred feet per mile. Against this slope, at the beginning of the coal epoch, a grand bed of bituminous shales and iron ore was deposited the confusedly mixed materials of Coal K. and accompanying strata. North and south from the bluff, the conglomerate is well exhibited, but here, a sudden westing of the stream has cut away the sandrock, exposing iron ores and shales as follows, viz:

SECTION AT CEDAR BLUFF, N. W. QR., SEC. 9, T. 22, R. 8.

Boulder and fluvial drift	40 to.....60 ft. 00 in.
Shale .....	12 ft. 00 in.
Band, averaging 7 in. iron ore.....	2 ft. 6 in.
Blue and black carbonaceous shale.....	11 ft. 00 in.
Banded nodules of iron ore ranging from 10 lbs. to a ton, av. 8 in. thick	.8 in.
Blue shale with iron nodules 4 to.....	8 ft. 00 in.
Conglomerate sandstone 0 to.....	25 ft. 00 in.
— —	
	119 ft. 2 in.

These bands and masses of iron are in sufficient quantity and quality to justify the belief that with facilities for transportation, they will pay for mining. On this horizon, iron ore may be found, hence north a short distance, and south as far as Dix's mills, with a probability of many paying deposits. One kidney-shaped mass of ore, eight feet long, three feet wide and one foot thick, would weigh more than a ton, while hundreds were seen weighing from one hundred to five hundred pounds. The quality is good. For analysis I refer to the Chemist's report.

Descending Pine creek, we find the eastern bank presents a bold front of precipitous or overhanging conglomerate, from sixty to one hundred feet high, capped by the laminated or quartzose beds accompanying the "place" of coal A., with massive or heavy bedded strata below. Beautiful pine trees shade the crest of the bluff. Irish and Virginia junipers are found on the slopes and bottoms. The dark shady valleys are crowded with ferns, and at Brier's stone quarry N. E. qr. N. E. qr. Sec. 16, T. 22, R. 8, the rocks were covered with climbing ferns (*Lygodium*), whose hastate fronds are armed with long hooked spikelets which reach forward, seize upon some object and then take root.

The quarries in this vicinity furnish an excellent quality of stone; brown, gray and snow white. It may be obtained in massive blocks, and split or broken in any direction desired; soft from the quarry, it hardens on exposure to the air.

On David M. Kelley's land, S. W. qr. N. W. qr., Sec. 15, T. 22, R. 8, is a quarry long worked for local use, presenting a bare outcrop of sixty feet; principally white free-stone, and combines with purity of color all the good qualities of this stone. Sills and lintels from this quarry in the house of Mr. Andrew Brier, after 18 years' exposure, show chisel marks and corners as sharp as if just from the hands of the workmen. The rocks of the quarry are covered with mosses and lichens further indicating their capacity to resist atmospheric action.

On Hogue's land N. E. qr. S. E. qr. Sec. 16, T. 22, R. 8, is a bed of kidney and banded ore carrying from thirty to fifty per cent of iron. The bands are of great thickness, and the concretions massive. The quantity indicated by the wash of the branch is large. Bog iron ore, probably in limited quantity, is reported on the land of Levi R. Van Reed, Sec. 31, T. 23, R. 8.

Deposits of washed sand and gravel found at Walnut Grove, and on the ridges which traverse the northwestern and western parts of the county, have been variously referred, by different authorities, to moraines of glaciers

or icebergs or the shore lines of an old lake. They are of fluviate origin, and date back to the infancy of our water courses, then having no deep or constant channel.

John Thomas works by stripping coal M, N. W. qr. Sec. 20, T. 22, R. 8, near where the State road crosses Fall creek. A heavy band of lean silicious iron ore, with fossils accompanies the roof shales. The pit was filled and specimens of coal were not obtained.

Matthias Luppoldt works coal L. at the place formerly known as the "Keister" bank N. W. qr. Sec. 21, T. 22, R. 8. Five entries have been driven on this seam in the southern bluff of Fall creek. In the bed of the creek coal K. has been found with its limestone roof, and on the hill side outcrops of M. are seen.

## SECTION AT LUPPOLDT'S BANK.

Slope .....	
Yellow sandstone.....	8 ft. 00 in.
Hard ferruginous argillite and iron stones, 2 ft. to .....	4 ft. 00 in.
Black sheety slate, 6 in. to.....	1 ft. 4 in.
Coal M., caking.....	1 ft. 10 in.
Fire clay.....	3 ft. 00 in.
Soapstone and shaly S. S.....	10 ft. 00 in.
Soapstone and sandy shale with ferns and coal plants.....	8 ft. 00 in.
Coal L, <i>worked</i> .	
Laminated coal.....	0 ft. 10 in.
Slaty coal.....	4 in.
Block coal.....	2 ft. 4 in.
—————	4½ ft. to 3 ft. 6 in.
Fire clay.....	4 ft. 00 in.
Blue shale, 6 ft. to.....	8 ft. 00 in.
Limestone or calcareous shale.....	2 ft. 6 in.
Black slate.....	10 in.
Coal K., under water, reported.....	3 ft. 4 in.
Fire clay—	not known.

— — —  
58 ft. 4 in.

Coal L dips to southwest one inch per foot. Coal K dips more rapidly.

The product of this mine bears an excellent reputation. It mines in blocks or slabs, has the heavy ring and dull lustre of block coal, and burns with little flame, to a white ash, without clinker. The seam ranges in thickness from 3 to  $4\frac{1}{2}$  feet, averaging three and a half feet. I add analysis from R. Owen's report 1860:

*Analysis of Keister's Coal.*

Volatile matter,	42.00	{ Gas,	-	-	-	40.00
		{ Water,	-	-	-	2.00
Coke,	-	-	58.00	{ Carbon,	-	51.05
				{ Ash,	-	6.05
			<hr/>			<hr/>
			100.00			100.00

This indicates a strong coal, rich in carbon. Amount mined in 1871, was 16,000 bushels; in 1872, 12,000 bushels. A test bore near the joined corners of sections 20, 21, 28, 29, found coals M. and L.; the latter, three and a half feet thick.

Andrew Fink works coal K. by three openings on W.  $\frac{1}{2}$  N. E.  $\frac{1}{4}$  Sec. 21, T. 22, R. 8, with the following exposure:

SECTION AT A. FINK'S BANK.

Slope.....	
Bit. limestone with fossils.....	2 ft. 00 in.
Calcareous shale, with fossils.....	0 ft. 09 in.
Black slate, with <i>Lingula</i> , etc.....	1 ft. 02 in.

COAL K.

Rough coal.....	0 ft. 06 in.	} 3 ft. 02 in.
Semi-block coal.....	1 ft. 04 in.	
Block coal.....	1 ft. 02 in.	
Soft shale.....	0 ft. 02 in.	
Fire clay.....	4 ft. 00 in.	

---

11 ft. 01 in.

This bank was but partially opened. It promises good coal.

A. C. Jarvis has one opening on N. E.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  of Sec. 21, T. 22 R. 8. His bank gives the following exhibit, viz

JARVIS' COAL SECTION.

Slope .....	
Black slate roof.....	4 ft. 00 in.
Coal K.	
Laminated pyritous coal	0 ft. 06 in. }
Semi-block coal.....	1 ft. 10 in. }
Block coal.....	1 ft. 02 in. }
Soft slaty coal.....	0 ft. 02 in. }
Fire clay.....	4 ft. 00 in.
	— —
	11 ft. 08 in.

This contains some sulphur, but presents a good appearance, and is largely *good block coal*.

At Dix's mill, N. W.  $\frac{1}{4}$  Sec. 22, T. 22, R. 8, a spur of conglomerate sandstone, once crossed the present channel of Pine creek. The stream has cut its way through this obstruction, exposing a triangular cross section at the west abutment of the present mill dam. Wedges of sandstone are thrown in against the sides of this spur, rounding over the sharp apex of the ridge, followed by strata of rock, iron ore, shale, and carbonaceous matter which arch over this hill of the ancient world.

In the bluffs of Pine, near the mouth of Fall creek, are many good beds of nodular and banded iron ore. At several points, bands outcrop, having a thickness of seven to nine inches. The nodules are often massive. One hundred tons weight might be "picked up" from surface washings. The quality is from fair to *first rate*.

Half a mile below the mouth of Fall creek, (center of Sec. 22, T. 22, R. 8), the bluffs of Pine creek contain a heavy deposit of black and dark colored carbonaceous shales, with a large amount of iron ore. The following section was taken, viz:



## REPTILIAN SECTION ON PINE CREEK.

Slope .....	
Black carbonaceous shale.....	3 ft. 06 in.
Bit. and Argil. limestone, with <i>Nautilus decoratus</i> and <i>Orthocerata</i> .....	2 ft. 03 in.
Blue and black shale, with banded, nodular and con- cretionary masses of iron ore, (place of Coal K).....	23 ft. 00 in.
Thinly laminated quartzose sandstone, with casts of sun cracks and reptilian tracks on the under side, and <i>fucoides</i> and <i>Chondrites</i> on the upper side of the lam- inae .....	1 ft. to 2 ft. 04 in.
Flaggy sandrock.....	3 ft. to 7 ft. 00 in.
Black Carb. shale, (place of Coal A.).....	2 ft. to 3 ft. 00 in.
Quartzose sandstone.....	08 in.
Dark shale.....	3 ft. 04 in.
Laminated sandstone.....	2 ft. 00 in.
Irregularly bedded sandstone	14 ft. 00 in.
	— —
	61 ft. 01 in.

The reptilian tracks which give importance to this section, are from the thinly laminated sandstone under the black shale, which contains the large iron nodules. A description and figure is published in this volume by Prof. Cox, to which I refer for particulars. One fragment exhibited four tracks, each having five toes. Two other tracks, somewhat indistinct, seem to have been made by the same animal. A smaller fragment showed a single, similar track.

On James Schoonover's land, leased by the Lafayette Mining Company, W. hf. S. E. qr. of Sec. 21, T. 22, R. 8 W., coal K is worked for the company under the direction

of Mr. Spurrier, to whom I am indebted for information. The entry was full of water and not seen.

## SECTION AT SCHOONOVER'S BANK.

Slope.....	30 ft. 00 in.
Calcareous shale or limestone.....	2 ft. 00 in.
Black slate roof.....	2 ft. 6 in.
Coal K.	
Choice coking coal.....	0 ft. 10 in.
Semi-block—some pyrite...	1 ft. 7 in.
Block coal.....	10 in.
Soft black slate.....	3 in.
	————— 3 ft. 6 in.
Fire clay .....	3 ft. 6 in.
	————— 41 ft. 6 in.

The specimens obtained for analysis had been exposed on the surface for a year. The seam locally dips an inch in ten feet to northwest. At this bank, as at those of Fink and Jarvis, the soft coaly shale at the bottom furnishes easy material on which to "bear in."

Three other bores were put down to the *horizon level* at which K is found at the mine, without results. If allowance had been made for the dip, the necessity of boring a few feet deeper, would have been obvious.

A shaft was sunk on the same farm to a depth of one hundred and twenty-five feet. Judging from the *ejecta* around the top of the shaft, the horizon of coal K was passed at a point where excavation made by the boulder drift had eroded the coal. The shaft terminated about the place of Coal A.

Contiguity of outcrops indicate a persistent seam of coal in a line from east to west of more than two miles. The quality is well suited for smelting iron. With facilities for transportation, anticipated by the proposed Lebanon and Michigan City Railroad, which passes through the heart of the Warren County coal fields, we may expect a full development of these valuable coals.

## ECONOMICAL GEOLOGY.

*Agriculture.*

It is believed that a good soil is the surest basis of a nation's comfort and prosperity. The people of this country ought to be comfortable, prosperous and happy. Nature has endowed them with a grand area of prairie, terrace level and bottoms, proportioned as five to one with the broken or hilly lands, which is covered with a black, deep, rich soil, producing large crops of corn and grass—the main reliance of profitable husbandry. No manure is used or required. An occasional crop of clover will restore and maintain the original fertility. The Kent and Tomlinson farms, among the earliest improved, are still noted for their heavy yield of corn and hay, although continuously cropped for nearly half a century. Bluegrass (*poa pratensis*) is indigenous; large pastures were found adjoining the Indian villages, which furnished winter feed for the horses of the tribe; and at an early day a wide belt of this grass marked the Indian trace by which Harrison's army marched to Tippecanoe. The introduced grasses thrive well. Other crops, as oats, rye, wheat and potatoes, are from fair to good, and may be equalled; but in the highly paying products, characteristic of this region, Warren county hardly admits of a rival.

The peculiar configuration of the Wabash and its affluents has moulded the general surface of this country into a great plane, sloping to the southeast. Thus an unusual preponderance of surface is presented to the warm rays of sunrise. As is well known, this is equal in effect to a much prolonged summer, and insures remarkable maturity and richness in the products of the garden, orchard and field.

Much attention has been paid to improved breeds of live stock. Success in this department was noted at the fair ground exposition; but more significant was the numerous herds of fat bullocks, luxuriating upon a noble sward of bluegrass. Timber for home use is in good supply, although not abundant. Hedges of osage orange are cultivated, and

it is believed will make a secure fence against horses, sheep and cattle. When necessary, local laws may require the owner to restrain his swine from trespassing on the public, and thus reduce the cost of fences one-half.

The deep, oozy loam of the grand prairie invites under-draining. Experience demonstrates that farmers can not make a better investment than the purchase and use of draining tiles. Health and comfort suggest that the first experiment by every land holder should be the thorough drainage of the grounds about the house, the garden and the barn.

#### CLAY.

Clay of good quality for bricks is found in nearly all parts of the county. The under clays of the coal seams are well developed, and are even of greater value than the coals. These afford first-class material for pottery, terracotta works and tile making. The supply is unlimited.

#### WATER POWER.

Several mills on Pine creek and Kickapoo, are driven by water, which is the cheapest possible power. The surplus water of these streams and flood water of Redwood may be profitably devoted to the sawing of stone. Several good mills on the line of the railway are propelled by steam.

#### WINDMILLS.

Water for farm and household use, is cheaply supplied by the use of self-regulating windmills. The satisfaction with which these engines are regarded by the grazers, is an indication of their merit. Not less than twenty were seen in successful operation.

#### ROAD MATERIALS.

Good roads, passable at *all* seasons, are necessary for the full enjoyment of civilization and social life. Experience shows that the best material known to road masters, is the gravel washed from the boulder drift. This county is richly supplied. Immense beds are found along the river and creek bluffs.

#### METALS.

Virgin copper and gold are found in small quantities. These metals, with small nuggets of galena, were imported from the north with the rocks of the boulder drift.

Tales of French Priests, locate silver and lead mines on Little Pine creek. No indications were seen, supporting such stories, or even allowing a possibility of their truth. Kidney and banded ores of iron, of good quality, are seen along the west side of Pine creek. The quantity will justify careful exploration and trial. These beds of calcareous and clay iron stones, with neighboring beds of block coal, invite the examination of iron masters.

#### STONE.

It will be seen from the foregoing pages that this county has extensive beds of quarry sandstone. Those of the conglomerate are especially worthy of mention. Blocks of any convenient size may be obtained, while the bright and vivid colors of the red and striped strata afford opportunity for ornament and contrast. The thinly bedded layers of Chester sandstone are often of great homogeneousness. Those on Redwood have been sawed. Specimens from the quarries east of town may be seen in the old buildings at Williamsport, erected for the county offices.

#### COAL.

The coals of this county are of good quality. Sufficient explorations have not been made to fully determine the quantity, yet enough to show a considerable deposit. It may be proper here to say, for the information of the people, that coal seams are rarely continuous over large areas; "horsebacks" occur, and barren places intervene in the best regulated coal fields. These interruptions grow in frequency and intensity as we approach the margin of the basin, where, owing to its physical structure, block coal is only found to occur. Such is the case at Brazil; such, too, in the Mahoning valley, where eight-tenths of the basin is

without coal. We may expect that this basin is governed by the law which is known to rule in other fields, and that basins or pools of coal will be found isolated and surrounded by much barren territory.

Again, while we see that the coal measures extend indefinitely west and southwest from the conglomerate rim of the basin, yet geologists have noted that the surface configuration is largely moulded by the underlying rocks; and we may infer that under the dividing ridge, which passes from the north in a south-south-westerly direction, through the western part of the county, on a hidden ridge of stone, makes the coal too thin to work along much of its extent. Hence, in attempting to guess at the extent of a drift covered and but slightly developed coal field, we can only say that its probable area is a basin from naught to three miles wide, commencing at Briscoe's bank, T. 23, R. 8, and extending, more or less continuously, and curving from this, westerly to Fall creek, thence south and east, by Coal branch and the valley of Possum run, to the Wabash. The same reasoning would indicate possible beds of coal along the State line in the north part of township 21, and the south part of township 22, both of range 8.

An abundant supply for home use has already been discovered; if the deductions here made are found to be true, a field of such an extent will allow a liberal margin for exportation.

#### RAILWAY FACILITIES.

The county is traversed from southwest to northeast by the Toledo and St. Louis road (T., W. & W. Ry.) The Indiana, N. & S. road, offers competing rates from Attica and the Indiana division of the C., D. & V. Ry. opens a route by that line to Chicago and the northwest. Citizens of the county feel that their agricultural and mineral products demand a direct route to the lake ports. They have organized a company and surveyed an eminently feasible route from West Lebanon to the north line of the county, in the direction of Michigan City. This road would traverse



a first class farming region, and at the same time, the richest and best developed mineral beds of the county.

#### ANTIQUITIES.

The terrace prairies were the favorite home of our most ancient American people. "Mound prairie," in the extreme southeastern part of the county, takes its name from clusters of mounds on its borders. Two large mounds were seen on the terrace bluff north of Kickapoo. Stone implements of good workmanship are common. A stone drill, in my cabinet, found at Independence, is made of hard horn-blend granite. It is pointed with two cutting edges, showing that the ancient artificers in stone, invented the mechanical contrivance used by his modern brother in piercing the hardest metals.

#### THANKS.

Thanks are returned to the citizens of Warren county generally for courteous assistance. Acknowledgements are due to the County Commissioners—Messrs. A. Brier, Sam'l Frame, and Zimri Atkinson—who appropriated funds to defray the expenses of this survey, and to the following persons for special favors: Wm. Moffitt, Hon. W. P. Rhodes, Dr. Boyer, L. Van Reed, J. Steele, J. Briscoe, Rev. Geo. Davis, L. Bittinger, J. A. Johnston, O. Munson, Dr. J. C. Deming, Dr. Fleming, the Lebanon Mining Co., W. Hasty, Perrin Kent, and the citizens at Marshfield.



**COLLETTOSAURUS INDIANAENSIS, NOV. SP.**  
natural size

## COLLETTOSARUS INDIANAENSIS.—Cox.

Mr. John Collett, while prosecuting the survey of Warren county, this fall, found in the carboniferous strata near the base of the coal measures, fossil foot prints of an air breathing reptile, to which I have given the name of *Collettosaurus Indianaensis*.

The tracks are the reverse casts which stand up in bold relief, and the entire face of the slab containing them exhibits a minute copy of the sun cracked surface of the plastic mud upon which they were impressed.

A natural sized figure is given of a portion of the slab; see opposite page.

Faint impressions of tracks on other portions not figured, may be readily discerned.

Two pairs of tracks of hind and fore feet are quite distinct, and from their position seem to indicate that the animal was allied to the *Batrachians*, and progressed like the frog, by jumps, while on the other hand the five digits on either foot relate it to the *Salamanders*.

Reptilian remains found in a similar geological horizon at Morris, in Grundy county, Illinois, are described in the Geological Report of Illinois, volume 2, by Prof. Edward D. Cope and referred by that distinguished comparative anatomist to the *Batrachians*; The head, vertebræ and a portion of the leg bones and phalanges are well preserved in Cope's *Amphibamus grandiceps* of Grundy county, and enabled him to recognize the blending of *Batrachian*, *Lacertian* and *Salamandrine* characters. While the foot-prints on the slab from Warren county afford no such guide of themselves, we may reasonably infer from the reptiles being close neighbors and correlated in time that while the five digits on the hind and fore feet are *Salamandrine* characters, the position of the tracks with reference to each other ally it to the *Batrachians*.

The impressions of the feet are in very great relief.

Each foot contains five toes, one of which, on the hind foot, measures three quarters of an inch in length; the spread is one and a quarter inches long and one inch broad, the space between the centres of the hind feet is three inches, between the fore feet one and a half inches. From the hind foot to the fore foot of each leg the space is four inches.

The character of the stratum containing these foot print slabs give assurance, as remarked by Prof. Collett, in his notes accompanying the specimen, that the entire deposit was found along a low beach subject to periodical overflows. The mud deposit, now shale, over which the reptile travelled, probably by jumps, as the position of the tracks seem to indicate, must have been quite soft, as the casts show a deep impression and remained long enough exposed to the influence of the air and sun to partially dry and become checkered with shrinkage cracks. The subsequent overflow covered it with a thin deposit of fine, blueish gray, siliceous mud which not only took a faithful impression of the tracks but, likewise, copied the sun-cracks. A small ridge on the upper part of the figured portion of the slab represents a small crack, while on a portion not figured there is an elevation, made in this way, one inch wide and five eighths high.

It is to be hoped that future research will develop other specimens that will enable us to determine more fully the character of these remarkable reptiles.

## ANALYSES OF COALS;

From Warren county, Indiana, collected by Prof. Collett and here described in the order of their arrangement in the tables of analyses at the end of this report:

## JOHN BRIGG'S COAL K;

Formerly known as the Steely farm, Sec. 11, T. 20, R. 9. Seam twenty inches thick; color, black; thin laminæ with carbonaceous partings; variety, block coal.

Specific gravity, 1.212.		One cubic foot weighs 75.75 lbs.	
Coke,	- - 50.50	{ Ash, flesh, - - - 2.00	
		{ Fixed carbon, - - - 48.50	
Volatile matter,	49.50	{ Water, - - - 4.75	
		{ Gas, - - - 44.75	
<hr/>		<hr/>	
100.00		100.00	

The coke is slightly swollen, laminate and vitreous. This is a good coal and free from earthy impurities.

## J. T. BRISCOE'S COAL L;

Sec. 29, T. 23, R. 8. Two feet four inches thick. Top part, brilliant black coal, with soft carbonaceous matter between the laminæ; variety, semi-caking coal.

*Upper part:*

Specific gravity, 1.223.		One cubic foot weighs 76.44 lbs.	
Coke,	- - 64.50	{ Ash, gray, - - - 7.00	
		{ Fixed carbon, - - - 57.50	
Volatile matter,	- 35.50	{ Water, - - - 3.50	
		{ Gas, - - - 32.00	
<hr/>		<hr/>	
100.00		100.00	

Coke puffed, brilliant and laminate.

*Middle part:*

One foot four inches thick, glossy black.

Specific gravity, 1.267.		One cubic foot weighs 79.18 lbs.	
Coke,	- - 62.70	{ Ash, blue, - - -	8.00
		{ Fixed carbon, - - -	54.70
Volatile matter,	- 37.30	{ Water, - - -	3.50
		{ Gas, - - -	33.80
	<hr/> 100.00		<hr/> 100.00

Coke not puffed, laminate and vitreous.

*Lower part :*

Somewhat sulphury.

Specific gravity, 1.350. One cubic foot weighs 84.37 lbs.

Coke,	-	-	68.25	{	Ash, blue,	-	-	-	16.00
				{	Fixed carbon,	-	-	-	52.25
Volatile matter,	-		31.75	{	Water,	-	-	-	3.00
				{	Gas,	-	-	-	28.75
			<hr/>						<hr/>
			100.00						100.00

Coke not puffed, laminate and vitreous.

Taken altogether this is a good and popular coal for steam and house use.

#### R. W. CLAYPOOL'S COAL L ;

Sec. 9, T. 20, R. 9, 2 ft. 6 in. thick.

*Upper part :*

One foot, brilliant black.

Specific gravity, 1.246. One cubic foot weighs 77.87 lbs.

Coke, - - -	58.50	{ Ash, red, - - -	10.00
		{ Fixed carbon, - - -	48.50
Volatile matter, - - -	41.50	{ Water - - -	3.00
		{ Gas, - - -	38.50
	<hr/>		<hr/>
	100.00		100.00

Coke puffed, vitreous and amorphous.

*Middle part :*

Ten inches, dull black, mineral charcoal partings.

Specific gravity, 1.214. One cubic foot weighs 75.87 lbs.



Coke, - - -	58.00	{	Ash, white, - - -	2.50
		{	Fixed carbon, - - -	55.50
Volatile matter,	42.00	{	Water, - - -	4.00
		{	Gas, - - -	38.00
	<hr/>			<hr/>
	100.00			100.00

Coke puffed, amorphous and brilliant.

*Lower part :*

One ft. 2 in., dull black, laminated structure, contains a little pyrites.

Specific gravity, 1.205. One cubic foot weighs 75.31 lbs.

Coke, - - -	63.00	{	Ash, brown, - - -	8.50
		{	Fixed carbon, - - -	54.50
Volatile matter,	37.00	{	Water, - - -	3.00
		{	Gas, - - -	34.00
	<hr/>			<hr/>
	100.00			100.00

Coke much puffed, vitreous, amorphous.

This is a very good quality of caking coal and meets with a ready market.

#### R. W. CLAYPOOL'S COAL M ;

Sec. 9, T. 20, R. 9. Upper seam, dull black, 1 ft. thick variety, caking coal.

Coke, - - -	51.50	{	Ash, brown, - - -	3.50
		{	Fixed carbon, - - -	48.00
Volatile matter,	48.50	{	Water, - - -	3.50
		{	Gas, - - -	45.00
	<hr/>			<hr/>
	100.00			100.00

Coke puffed, lusterless.

#### GOODRICK'S COAL M.

Sec. 2, T. 20, R. 9. Upper seam, dull black caking coal, 1 ft. 6 in.

Specific gravity, 1.343. One cubic foot weighs 83.93 lbs.

Coke, - -	54.50	{ Ash, red, - - -	9.50
		{ Fixed carbon, - -	45.00
Volatile matter,	45.50	{ Water, - - -	6.00
		{ Gas, - - -	39.50
<hr/>		<hr/>	
100.00		100.00	

Coke brilliant, laminate, not puffed.

#### GOODRICK'S COAL L.

Sec. 2, T. 20, R. 9; lower seam, glossy black, brittle, caking coal; 3 ft. thick.

*Upper part:*

Eight inches.

Specific gravity, 1.304. One cubic foot weighs 81.50 lbs.

Coke, - -	55.00	{ Ash, purple, - -	8.50
		{ Fixed carbon, -	46.50
Volatile matter,	45.00	{ Water, - - -	3.00
		{ Gas, - - -	42.00
<hr/>		<hr/>	
100.00		100.00	

Coke slightly puffed, laminate, lusterless.

*Lower part:*

Fourteen inches, jet black and brittle.

Specific gravity, 1.262. One cubic foot weighs 98.87 lbs.

Coke, - -	50.00	{ Ash, flesh, - -	4.50
		{ Fixed carbon, -	46.00
Volatile matter,	49.50	{ Water, - - -	3.00
		{ Gas, - - -	46.50
<hr/>		<hr/>	
100.00		100.00	

Coke puffed, vitreous, amorphous.

This is an excellent coal for steam and domestic uses.

#### HOOPER & BARRINGER'S COAL L.

Sec. 8, T. 20, R. 9; dull, black, laminated block coal, with charcoal partings; worked from a shaft; seam 2 ft. 8 in. thick.

*Upper part :*

Ten inches.

Specific gravity, 1.238. One cubic foot weighs 77.37 lbs.

Coke, - -	61.50	{	Ash, white, - -	2.50
		{	Fixed carbon, - -	59.00
Volatile matter,	38.50	{	Water - - -	4.00
		{	Gas, - - -	34.50
	100.00			100.00

Coke, laminate, vitreous, not swollen.

*Lower part :*

Twenty-two inches, mined in large blocks.

Specific gravity, 1.236. One cubic foot weighs 77.25 lbs.

Coke, - -	58.50	{	Ash, white, - -	2.50
		{	Fixed carbon, - -	56.00
Volatile matter,	41.50	{	Water, - - -	6.50
		{	Gas, - - -	35.00
	100.00			100.00

Coke, brilliant, laminate, not swollen.

This is an excellent quality of block coal.

## HAROLD &amp; CO'S COAL L.

Sec. 9, T. 20, R. 9. Brilliant black caking coal, 2 ft. 8 in. thick.

*Upper part :*

One foot.

Specific gravity 1.282. One cubic foot weighs 80.15 lbs.

Coke, - -	60.50	{	Ash, red, - -	6.50
		{	Fixed carbon, - -	54.00
Volatile matter,	39.50	{	Water, - - -	3.50
		{	Gas, - - -	36.00
	100.00			100.00

Coke not puffed, laminate, vitreous.

*Middle part :*

Six inches, good gas coal.

Specific gravity, 1.290.		One cubic foot weighs 80.62 lbs.	
Coke,	- - 57.00	{ Ash, white, - - -	7.50
		{ Fixed carbon, - - -	49.50
Volatile matter,	43.00	{ Water, - - -	4.50
		{ Gas, - - -	38.50
<hr/>		<hr/>	
100.00		100.00	

Coke puffed, amorphous, vitreous.

*Lower part:*

One foot two inches dull black, laminated, with soft carbon partings.

Specific gravity, 1.252.		One cubic foot weighs 78.25 lbs.	
Coke,	- - 59.50	{ Ash, white, - - -	3.50
		{ Fixed carbon, - - -	56.00
Volatile matter,	40.50	{ Water, - - -	9.50
		{ Gas, - - -	31.00
<hr/>		<hr/>	
100.00		100.00	

Coke, slightly swollen, laminate, vitreous.

This coal looks well and shows no sulphur bands.

A. C. JARVIS' COAL K.

Sec. 22, T. 23, R. 8. Block coal, 3 ft. 9 in. thick.

*Upper part:*

Six inches.

Specific gravity, 1.243.		One cubic foot weighs 77.68 lbs.	
Coke,	- - 57.00	{ Ash, red, - - -	6.50
		{ Fixed carbon, - - -	50.50
Volatile matter,	43.00	{ Water, - - -	5.00
		{ Gas, - - -	38.00
<hr/>		<hr/>	
100.00		100.00	

Coke, vitreous, slightly puffed, laminate.

*Middle part:*

One foot ten inches; dull, black, laminated structure, soft carbon partings.

Specific gravity, 1.251.		One cubic foot weighs 78.18 lbs.	
Coke, - -	56.50	{ Ash, white, - -	3.00
		{ Fixed carbon, - -	53.50
Volatile matter,	43.50	{ Water, - - -	2.75
		{ Gas, - - -	40.75
<hr/>		<hr/>	
100.00		100.00	

Coke slightly puffed, laminate, vitreous.

*Lower part :*

One foot two inches; laminated structure.

Specific gravity, 1.348. One cubic foot weighs 84.25 lbs.

Coke, - -	63.50	{ Ash, white, - -	12.00
		{ Fixed carbon, - -	51.50
Volatile matter,	36.50	{ Water, - - -	3.50
		{ Gas, - - -	33.00
<hr/>		<hr/>	
100.00		100.00	

Coke unchanged, laminate, lusterless.

The middle part of this seam is an excellent quality of block coal; the upper and lower parts are of fair quality.

#### LUPPOLDT'S COAL L.

Sec. 22. T. 23, R. 8. Semi-block, 3 ft. 6 in. thick.

*Upper part :*

One foot dull black, laminated structure.

Specific gravity, 1.222. One cubic foot weighs 76.37 lbs.

Coke, - -	58.50	{ Ash, dark red, - -	9.50
		{ Fixed carbon, - -	49.00
Volatile matter,	41.50	{ Water, - - -	4.50
		{ Gas, - - -	37.00
<hr/>		<hr/>	
100.00		100.00	

Coke slightly swollen, brilliant, laminate.

*Middle part :*

Four inches, laminated, with soft carbon partings.

Specific gravity, 1.254. One cubic foot weighs 78.37 lbs.

Coke, - -	61.50	{ Ash, red, - - -	9.00
		{ Fixed carbon, - -	52.50
Volatile matter,	38.50	{ Water, - - -	5.00
		{ Gas, - - -	33.50
<hr/>		<hr/>	
100.00		100.00	

Coke not swollen, laminate, lusterless.

*Lower part :*

Two feet, two inches ; clean, pure coal.

Specific gravity, 1.256. One cubic foot weighs 78.50 lbs.

Coke, - -	61.50	{ Ash, white, - - -	4.50
		{ Fixed carbon, - -	57.00
Volatile matter,	38.50	{ Water, - - -	3.00
		{ Gas, - - -	35.50
<hr/>		<hr/>	
100.00		100.00	

Coke laminate, lusterless, unchanged.

This seam, taken altogether, furnishes an excellent quality of coal.

#### SCHOONOVER'S COAL K.

Sec. 21, T. 22, R. 8 ; dull black, laminated block coal with soft carbon partings, 3 ft. 6 in. thick.

*Upper part :*

Ten inches.

Specific gravity, 1.284. One cubic foot weighs 80.25 lbs.

Coke, - -	58.90	{ Ash, red, - - -	9.50
		{ Fixed carbon, - -	49.40
Volatile matter,	41.10	{ Water, - - -	3.50
		{ Gas, - - -	37.60
<hr/>		<hr/>	
100.00		100.00	

Coke not swollen, laminate, vitreous.

*Lower part :*

Two feet, eight inches.

Specific gravity, 1.229. One cubic foot weighs 76.81 lbs.



## WARREN COUNTY.

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Coke, - - -	61.50	{ Ash, dark red, - - -	6.25
		{ Fixed carbon, - - -	55.25
Volatile matter, -	38.50	{ Water, - - -	4.50
		{ Gas, - - -	34.00
	<hr/>		<hr/>
	100.00		100.00

Coke not swollen, laminate, vitreous.

A fair article of block coal.

## JOHN THOMAS' COAL M.

Sec. 20, T. 22, R. 8; caking coal, 20 in. thick.

Specific gravity, 1.415. One cubic foot weighs 88.43 lbs.

Coke, - - -	62.00	{ Ash, red, - - -	12.50
		{ Fixed carbon, - - -	49.50
Volatile matter, -	38.00	{ Water, - - -	4.50
		{ Gas, - - -	33.50
	<hr/>		<hr/>
	100.00		100.00

Coke slightly swollen, laminate, lusterless.

## TINKLER &amp; CO'S COAL L.

Sec. 2, T. 20, R. 9; caking coal, 3 ft. 1 in. to 4 ft. 2 in. thick.

*Upper part:*

Seventeen inches, glossy black with conchoidal fracture.

Specific gravity, 1.257. One cubic foot weighs 78.56 lbs.

Coke, - - -	53.50	{ Ash, pale red, - - -	3.50
		{ Fixed carbon, - - -	50.00
Volatile matter, -	46.50	{ Water, - - -	3.00
		{ Gas, - - -	43.50
	<hr/>		<hr/>
	100.00		100.00

Coke vitreous, slightly puffed, amorphous.

*Middle part:*

Eight inches; dull black, laminated structure.

Specific gravity, 1.282. One cubic foot weighs 80.12 lbs.

Coke, - -	50.00	{ Ash, blue, - -	3.00
		{ Fixed carbon, - -	47.00
Volatile matter,	50.00	{ Water, - - -	5.50
		{ Gas, - - -	44.50
	100.00		100.00

Coke puffed, amorphous, vitreous.

*Lower part :*

One foot, jet black, laminated structure.

Specific gravity, 1.244. One cubic foot weighs 77.75 lbs.

Coke, - -	55.50	{ Ash, red, - - -	5.00
		{ Fixed carbon, - -	50.50
Volatile matter,	44.50	{ Water, - - -	2.00
		{ Gas, - - -	42.50
	100.00		100.00

Coke puffed, amorphous, vitreous.

#### CEDAR BLUFF IRON ORE.

Secs. 4 and 9, T. 22, R. 8. Iron stone in nodules forming a continuous band 8 to 10 in. thick.

*Specimen No. 1.*

Insoluble silicates.....	10.100
Protoxide of iron.....	47.862
Protoxide of manganese.....	.718
Alumina .....	2.490
Lime .....	3.330
Magnesia .....	.218
Loss by ignition, carbonic acid, water and undetermined .....	35.282
	100.000

Metallic iron, 37.24.

*Specimen No. 2.*

Insoluble silicates.....	11.700
Protoxide of iron.....	48.078
Protoxide of manganese.....	.837
Alumina .....	1.890
Lime .....	4.480
Magnesia.....	.230
Loss by ignition, carbonic acid, water and undetermined .....	32.785
	<hr/>
	100.000

Metallic iron, 37.415.

This is a good and valuable ore. The iron exists, mostly, as a carbonate of the protoxide of iron.