

ORANGE COUNTY.

PROF. E. T. COX,

State Geologist.

DEAR SIR:—We herewith submit a Report of a Geological Survey of Orange county.

Thanking you for valuable aid, and for many courtesies,
we are Yours,

M. N. ELROD, M. D.

E. S. McINTIRE, M. D.

Orleans, Ind., December 30, 1875.

DESCRIPTION.

Orange county is one of the second tier of counties in the southern part of the State. It is nearly square, and has an area of four hundred square miles. It is bounded on the north by Lawrence, on the west by Martin and Dubois, on the south by Crawford, and on the east by Crawford and Washington counties.

Topographically it may be divided into two divisions, corresponding to the St. Louis and Chester formations. The first district, embracing the northeast part of the county, is comparatively devoid of hills, but much cut up and broken by the sinkholes and basins so peculiar and characteristic of the concretionary limestone regions of Lawrence, Washington and Harrison counties of this State, and parts of Kentucky. These basins are not so

deep as to seriously interfere with farming, and lend variety to an otherwise monotonous level. Along the banks of Carter's creek, and between Carter's creek church and Lost river, is a range of moderately high bluffs that are, to a certain extent, the counterpart of the St. Louis limestone hills of Sugar creek, in Lawrence county. The second division, embracing the southern, western and central parts of the county, is hilly and broken. Some of these hills rise to an altitude of three hundred feet above the neighboring valleys. Much of this district is cut up by ranges of high ridges that follow the course of the creeks and rivers, and few gaps of communication are open from one valley to another. The scenery is wild and picturesque. The high, castellated bluffs of sand and the lichen-covered rocks of massive limestone awaken in the beholder feelings of awe at the vast power that has, in past ages, been brought into action in eroding and excavating the deep valleys he sees on every hand. Where once the waves of a mighty ocean beat, there is now but the gentle murmur of some rivulet. Beautiful views of the surrounding country may be had from the hill-tops in the vicinity of Orangeville, Paoli and French Lick, and few other regions of country furnish such cozy and healthful nooks in which to build pleasant homes.

NATURAL DRAINAGE.

Patoka and Lost rivers, and their tributaries are the principal streams. Their general course is from east to west, while the course of their tributaries is from northeast and southeast to northwest and southwest. The range of high lands and ridges, as may be seen on the map, running from east to west through Jackson, the north part of Greenfield and Southeast townships, form the divide between the headwaters of these two streams. Patoka rises in Stamper Creek township, and drains the southern third of the county, and empties into the Wabash, below the mouth of White river. Its principal tributaries in the county are Cane creek and Young's creek and Golden's

creek on the north, and Grimes' creek on the south. Tucker's creek empties into it at the bend above Newton Stewart's farm, in Crawford county. Lost river and its branches, Carter's creek, Lick creek, and French Lick creek drain the central and northern parts of the county. It rises in Washington county, and empties into the East Fork of White river, in the southern part of Martin county. Lick creek is the largest tributary. It and French Lick creek are the tributaries from the south, with the exception of Lost river, above the first sink and Stamper's creek, that have their sources in the St. Louis limestone. All the principal springs of the county break at the top of the lower and middle Chester limestones, and being charged with carbonate of lime, are known as hard waters. None of these streams are of very great economic importance, yet several flouring mills are in successful operation on Patoka and Lost rivers. With good dams and machinery that would utilize all the power, they might be made much more profitable.

GENERAL GEOLOGY.

The rocks of Orange county all belong to the great Carboniferous Age or Age of Coal Plants, and to the Sub-carboniferous period, except a narrow belt of Carboniferous conglomerate, the base of the true coal measures found on the west side of the county.

The strata dip from east to west, with a slight bearing to the south. The dip is not quite uniform; for miles it appears to be at the rate of fifteen feet to the mile. Exceptions may be seen in the north side of the hill, west of French Lick springs, where the dip is to the west at the rate of one hundred feet to the mile, and on the bank of Lick creek, on the road from Paoli to Vincennes, where it is to the east, but these are only local irregularities. The oldest rocks are found in the northeast part of the county, hence, in passing from east to west, we advance successively from the lower to the higher or more recent deposits.

The subjoined connected section is made from local sections taken at isolated points on or near the course of Lost river and Lick creek. The numbers in the first column refer to the general divisions, while those in the second refer to the local sub-divisions. References by number in the following pages refer to the general divisions of the first column.

CONNECTED SECTION OF ORANGE COUNTY.

Quaternary, or Age of Man.

	Ft.	In.
1. Alluvium and soils.....	10	00
2. Lacustral and drift.....	25	00

CARBONIFEROUS AGE.

Carboniferous Period.

3. Conglomerate, or Millstone epoch.		
1. Coarse sandstone, locally filled with pebbles, heavy bedded or friable.....	40	00
2. Coal, probably Coal A.....	1	06
3. Sandstone, or shale.....	60	00
4. Siliceous iron ore.....	5	00
5. Massive sandstone, irregularly bedded and at the base filled with leaves and stems of <i>Stigmara</i>	20	00
6. Whetstone grit, fine grained, even bedded, with shaly partings, the lower member highly fossiliferous. <i>Paoli vetusta</i> , <i>Lepidodendron obovatum</i> , Sternb. <i>L. Valtheimianum</i> Sternb. <i>L. dichotomum</i> , Sternb. <i>Sphenopteris latifolia</i> Brgt. <i>S. tridactylis</i> , Brgt. <i>Neuropteris Smithii</i> Lesq. <i>N. Elrodi</i> Lesq. (sp. n.) <i>Stigmara</i> , <i>Cordaites</i> , etc.....	24	00
7. Shale, with fossils.....	2	00
8. Coal, with underlying fire-clay.....	1	00
9. Shaly sandstone.....	3	00
10. Massive sandstone, locally glass sand, where sufficiently firm, grindstone grit.....	35	00

SUB-CARBONIFEROUS PERIOD.

Chester Group.

4. Chester limestone. No. 3 or upper.
 1. Limestone, cherty at the top. Fossils—*Athyris subtilita*, *A. Royissii*, *Pentremites pyriformis*, *Archimedes Wortheni*, *Zaphrentis spinulosa*, *Spirifer lineatus*, and *Producti*..... 17 00
5. Chester sandstone. No. 3 or upper.
 1. Heavy bedded and massive, locally the true grindstone grit, in some places red and blue shales near the base..... 105 00
6. Chester limestone. No. 2 or middle.
 1. Massive and heavy bedded. Fossils same as upper 25 00
7. Chester sandstone. No. 1 or lower.
 1. Heavy bedded or shaly, red or blue..... 5 00
 2. Coal, generally persistent..... 04
 3. Sandstone or shale, locally quarry-stone and flagging. Fossils—*Stigmaria* leaves and stems 30 00
8. Chester limestone. No. 1 or lower.
 1. Limestone, massive and heavy bedded, locally quarry-stone. Fossils—*Pentremites pyriformis*, *Terebratula bovidens*, *Bellerophon carbonarius*, *Rhynchonella subcuneata*, *R. mutata*, *Trilobites*, etc 50 00
 2. Chester chert, non-fossiliferous..... 1 00
 3. Limestone, locally lithographic. Fossils—*Spirifer striatus*, *Terebratula bovidens*, *Rhynchonella subcuneata*, *Syringopora mult-attenuata* *Producti*, etc..... 40 00

ST. LOUIS GROUP.

9. Chert.
 1. Highly bryozoic. Fossils—*Productus cora*, *P. semi-reticulatus*, *Bellerophon levis*, *Dentalium primum*, *Athyris ambigua*, *Platyceras* (sp.?) *Zaphrentis spinulosa*, *Hemipronites crenistria*, *Spirifer striatus*, *Allorisma*, *Pinna*, *Lithostrotion Canadense*, *L. proliferum*, and *Chenomya rhomboidea*?..... 3 00
10. Concretionary limestone.
 1. Locally an even bedded, magnesian fire-stone, at other points massive and concretionary. Fossils much same as chert.. 50 00

11. Limestone, locally cement	3 00
12. Porous limestone.....	4 00
13. Argillaceous limestone, hydraulic.....	15 00
14. Cannel coal.....	a trace.
15. Bituminous limestone.....	10 00
Total	<u>583 10</u>

LOCAL GEOLOGY.

St. Louis Group.

The St. Louis limestones and cherts are the surface rocks of the northeast part of the county and embrace an irregular area of about seventy-four square miles, within which are included the whole of Northeast, much the larger part of Orleans, the northeast corner of Paoli and the northern part of Stamper's Creek townships. The region of country under consideration, is broken by a range of bluffs that set in at the first sink of Lost river and run up Carter's creek to Carter's creek church, and thence south to Lost river. These bluffs vary in height from forty to fifty feet, and seem to be a continuation of the group of Lower Chester limestone hills shown on the map as occurring in the southeast part of Orleans township. It is not probable they are the anticlinal of an upheaval but the result of a general system of erosion to which the whole county has been subjected, and as they form the southern limits of the Lacustral clays of Northeast township and determine the course of Carter's creek, it is reasonable to suppose they were in existence prior to the close of the drift period. Besides the bluffs, the surface of the country is broken by peculiar basin-shaped cavities known as *sinkholes*. These basins vary in depth from a few inches to forty or more feet and from a few yards to five acres in area. The larger ones invariably show broken fragments of chert on the sides. Usually this exposure of chert is much the most conspicuous on the northern and eastern parts, while the other sides have the greatest depth of soil and clay.

A peculiar feature of the country covered with sinkholes, is the absence of springs and brooks or any continuous system of surface drainage. The excess of rain-fall would accumulate in the basins and form ponds were it not that they nearly all have subterranean channels through which the excess of water is carried off. When these openings become closed, lasting ponds are formed, and this is very liable to be the case, after the surrounding lands are put under cultivation, from the wash that is carried into them from the adjoining slopes. Especially is this the case along the roadsides and in old fields where the wash is largely mixed with red clay that soon forms an impervious bottom. The remedy is to keep the original underground channel open.

The lithological characters of the St. Louis rocks are extremely variable, changing within a few yards, so that no two sections will give exactly the same results. The age and relative position of each strata can only be determined by its fossils, and this is often rendered much more difficult by their absence. It seems, however, that the strata becomes thicker and more uniform both in structure and fossils as we advance to the west.

As it is only the upper members of the St. Louis group that are seen in Orange county, we did not have an opportunity to determine the exact succession of the strata, and their relations in the outcrops in Lawrence and Washington counties. The solving of this question is rendered more difficult by the clays and sands that cover the older rocks and prevent the study of the strata in any direct line of exposure. But from an examination of the southern part of Lawrence county, in Bono township, we found that the highest and most recent rocks seen north of the lacustral clays and within one mile of the county line, were the Vermicular limestones of Prof. Collett. The Bedford limestone occupies a still lower geological horizon, immediately under the Vermicular, and can be had in vast quantities from the banks of Sugar creek. It is to this region the

people of the northeast corner of this county should look for good building stone.

The bituminous limestone, No. 15 of the connected section, is seen on the west bank of Carter's creek, on the farm of C. Weires, section 32, township 3 north, range 1 east, at which place the following section was made:

SECTION NO 1, CARTER'S CREEK.

Covered space.	
Argillaceous limestone, hydraulic.....	12 ft.
Cannel coal seam, No. 1 of connected section.....	trace.
Bituminous limestone.....	10 ft.
Total	<u>22 ft.</u>

At this place, and on the farm of J. M. Greenslade, near the county line on Lost river, the bituminous limestone is an even, heavy-bedded stone of a dark bluish or black color that emits a fetid odor when struck with the hammer. On exposure to the weather it exfoliates and splits into thin laminae. It outcrops in the deep holes along the bottom of Carter's creek down to Island church, and down Lost river to Trimble's grave yard. The next stratum in ascending order is a thin seam of impure cannel coal, ranging from a mere trace to four inches in thickness. Along Carter's creek it is constant. Near Island school house, during high water, it is washed up from the bed of the creek, and as it burns readily when thrown on a blazing fire, many persons have supposed that by digging into the bluff it would be found in paying quantities. As no workable beds of coal have heretofore been found so low down in the geological scale as this, time and money spent prospecting will only result in disappointment.

Above the coal trace next in order comes the argillaceous limestone, No. 13 of the connected section: At its base, on Carter's, it is a compact, thin-bedded, grayish stone, having a sub-conchoidal fracture that indicates hydraulic properties. On Lost river it is more earthy, and at the Trimble farm has an exposure of over thirty feet. At the farm of E. Elliott, section 6, township 2 north, range 1 east, it has

a thickness of fifteen feet, and in the middle and top portions is very earthy, equal to rotten stone, that may be of local value as a polisher. The subjoined section was made above the spring at this place:

SECTION NO. 2, CARTER'S CREEK.

Slope, with fragments of chert, thin bedded stone, No. 11 of the connected sections, fossils, valves of <i>Spirifer</i> and <i>Retzia</i>	3 ft.
Porous limestone, No. 12 of the connected section	4 ft.
Argillaceous limestone, No. 13 of connected section	15 ft.
Total	<u>22 ft.</u>

No well preserved fossils were seen except in the chert. In the argillaceous strata we found a large cast of *Bellerophon*. A few pieces of a dark flint stone, filled with the peculiar little fossils so abundant at Spergen hill and other places in the lower beds of the St. Louis group, were found. The porous limestone here seen has much the appearance externally of the Vermicular of Lawrence county, but is a softer, earthy stone. It will not make good lime. In fact, none of the stone seen in this region will prove of much economic value, unless as a cement rock. The lithological characters of the strata change rapidly in passing down Lost river and Carter's creek, so that at the bluff east of Nebo, while the thin-bedded stone No. 11 still retains its appearance, the other members have become much more compact. Opposite the bluff, a stone, the equivalent of the argillaceous, has been quarried for foundations of houses, but is too soft to stand the weather. At the crossing of the Orleans and Livonia road, on Lost river, all the strata have become compact except the porous limestone, at which place we made the following section:

SECTION NO. 3, FORD OF LOST RIVER.

Slope, containing fragments of chert with fossils, <i>Lithostrotions</i> , <i>Producti</i> , <i>Bellerophon levis</i> , <i>Dentalium</i> , etc.	16 ft.
Concretionary limestone, No. 10 of the connected section, with numerous fossils, <i>Productus cora</i> , <i>Spirifer</i> , plates and spines of <i>Archæocidaris Wortheni</i> and crinoid stems.....	24 ft.

Porous limestone, No. 12 of the connected section.....	6 ft.
Compact limestone, No. 13 of the connected section...	10 ft.
Total	<u>56 ft.</u>

The concretionary limestone of the above section might, with equal propriety, be called *Bryozoic Dentalium*, or lithographic limestone. If we correctly interpret Prof. Cox's remarks in "Geological Survey of Indiana, 1870," page 139, this is the equivalent of the lithographic stone of Harrison county. Here it is massive stone of a grayish color, generally breaking with a chonchoidal fracture, and in texture presenting the characters of a lithographic stone. The concretions found in it are in thin, flat plates or nodules. The rounded forms are without fossils, and correspond to the amorphous geodes of Prof. Collett, in his report on the geology of Lawrence county. They are of all forms and shapes, and frequently present a striking resemblance to the head of some animal or a fruit. The laminated form occurs in irregular masses, ranging from a few lines to two or more inches in thickness, and from one to three feet in diameter. They are of a darker and more flinty appearance than other cherts, and are nearly always fossiliferous. This strata is the limestone generally met with beneath the chert and soil at Orleans, and in Orleans, Paoli and Stamper's Creek townships. It is the limestone exposed over a belt of country varying from four to five miles wide, running from Orleans towards Livonia. Good exposures may be seen on Lost river, east of the farm of James A. Frost, in section 2, township 2 north, and range 1 west, and at the railroad cut east of Orleans. Below the third sink of Lost river it becomes more magnesian, is almost destitute of bryozoans, and scarcely ever lithographic. At the fourth sink of Lost river, on the farm of B. C. Elrod, the following section was made by Prof. Richard Owen, in his Geological Survey of Indiana, 1859-60, page 143. It is here inserted for comparison, and as exemplifying the changes and differences in this strata at different points:

SECTION NO. 4, AT FOURTH SINK OF LOST RIVER.

General level of surrounding farms.....	25 to 30 ft.
High water mark	6 ft.
Chert in loose masses on river bank.....	2 to 4 ft.
Crystalline limestone.....	8 to 10 ft.
Thin shales and detritus.....	10 ft.
Soft magnesian limestone.....	46 ft.
Lithostrotion limestone	8 to 18 ft.
Disappearance of the river.....	8 to 10 ft.
Subterranean level near the gulf, above the sea	430 ft.

From the same author we learn that, according to Col. Stansbury and Mr. Williams, the court house at Paoli is 599 feet above the level of the sea, and consequently 169 feet above the sink of Lost river.

Producti and *Spirifer striatus* were noticed in all the strata, together with fragments of *Archæocidaris Wortheni* in the upper crystalline member, and *Lithostrotion Canadense* in the chert. Outcrops of a still darker and less fossiliferous stone, of the same horizon as that under consideration, may be seen at the cave spring, at the crossing of the Orleans and Vincennes road, on the dry bed of Lost river, and at the Wesley Chapel gulf. The top member of the concretionary limestone, at many places is very evenly bedded, the laminae ranging in thickness from one inch to two feet. This form of the rock is locally known as *firestone*, and is in repute for making jambs and hearths, where it will not be subjected to a very high temperature. It splits with wonderful evenness, and may be broken into almost any shape wanted, with the hammer. It outcrops on the farm of Ben. P. Chatham, southeast of Orleans, where the following section was made:

SECTION NO. 5, ON FARM OF B. P. CHATHAM.

Slope covered.....	16.00
Building stone, white and fine grained, No. 8.....	6.00
Lithographic limestone, No. 8 of connected sections...	18.00
Chert, fossiliferous, No. 9 of connected sections.....	2.00
Firestone, thin bedded above, No. 10.....	10.00
Massive limestone, No. 10.....	12.00
Total	<u>64.00</u>

The firestones also outcrop on the road from Orleans to Orangeville just west of the crossing of Lost river below Alfred Bruner's farm, and on his farm, also near Orangeville and north of the sand hill near Orleans.

The cherts, No. 9 of the connected section, are the most conspicuous and widely distributed of the rocks of the St. Louis group. Having resisted the eroding action that has worn away the less resisting limestones, they are everywhere strewn over the surface of the ground, and buried in the red clays. Besides the regular beds under consideration vast quantities of smaller specimens are from the concretionary limestone. Lithologically they differ very much in hardness, fracture and color. Those found on the western and southern borders of the St. Louis limestones are characterized by a highly red color, derived from the infiltration and deposit of hydrous peroxide of iron, while those found in the northeast part and along Stamper's creek are stained a brown color by the brown oxide, giving them much the appearance of chalcedony. In hardness they are equally variable; those that are highly bryozoic are soft and easily broken or split, but usually breaking or crumbling into irregular fragments; those that are very hard break into square or wedge-shaped pieces. Exposures of these last may be seen on the Orleans and Paoli road. Aside from the valves of a spirifer seen sticking on the surface of stone they are not fossiliferous. Near Cave spring and on the lower dry bed of Lost river where the chert forms the surface rock and has not been disturbed by the forces that have removed the superincumbent limestone, we find it very hard and silicious, of a gray color and abounding in fossils. At these points it is a true *buhrstone*, and has been used as such in making a run of stone in the old Orangeville mill. The distribution of these rocks have been sufficiently indicated above. The bryozoans found in it are frequently most perfect and beautiful, and belong to some one or more species of *Polypora*, probably *P. gracilis* and *P. Hamiltonensis*. Specimens of a *Pinna* are found in it, measuring over five inches in length. No crinoids have been found,

though portions, ossicles, of stems are not infrequent, and one very pretty little star fish was picked up near Orleans. The cherts, when decomposed in consequence of the free admixture of iron, give rise to the red clays (paint). The chert may be seen in place on the farm of B. P. Chatham, at the rise of Stamper's creek, near the residence of George VanCleve, and at the Wesley Chapel gulf, where the following section was made:

SECTION NO. 6, AT WESLEY CHAPEL GULF.

Slope, with sandstone capping the hill, massive limestone, with shaly partings and thin beds of argillaceous stone	60.00
Chert, fossiliferous No. 9 of connected section.....	3.00
Concretionary limestone to low water No. 10.....	30.00
Total	<u>93.00</u>

CHESTER GROUP.

Within this group is embraced the remaining undescribed limestones and all the sandstones, except those capping the hills on the west and south part of the county, that form a part of the conglomerate or millstone grit epoch. The eastern boundary has been sufficiently defined in describing the St. Louis. It is difficult to give that on the west without a map. Suffice it, that a line starting on the north, five miles east of the northwest corner of the county and running south to French Lick springs, thence in curvilinear course to the south part of the county, west of Valeene, will be nearly correct.

Beginning at the base of the group we have first the lower Chester limestone, No. 8, which, in many respects, is a peculiar formation, especially as to thickness, when compared with the other strata, ranging from sixty to ninety feet, and in its greater uniformity of lithological characters and structure. Unlike the other limestones that are so variable, so far as we have seen, one section, with slight modification, might be made to answer for the whole county. Taken as a whole, it is a massive crystalline stone,

frequently lithographic, very evenly stratified, often with the heavier beds at the top.

A portion and sometimes the whole of this limestone has been referred to the St. Louis group. We think we have good and sufficient paleontological reason for putting it in the Chester. The fossils found in it, besides those enumerated in the connected section, are those that have heretofore been regarded as characteristic of the Chester group, and some of them, especially *Bellerophon carbonarius*, as confined to the coal measures. None of the fossils of the St. Louis limestone and cherts have been found in it, except those that are known to have a very great vertical range, as the *Spirifers* and *Producti*, *Lithostrotion Canadense* and *L. proliferum*. Fossils peculiar to the St. Louis group have been found in great quantities in and below the St. Louis chert, (No 9), but *never* above it. The absence of these two fossils alone, we take it, is sufficient reason for making the division where we do, between the Chester and St. Louis. In coming to these conclusions we are greatly indebted to Prof. E. T. Cox, State Geologist, to whom was submitted for examination, a tolerably complete suite of fossils, from this horizon.

SECTION NO. 7, SAND HILL NEAR ORLEANS.

Slope.	
Sandstone, base glass sand, No. 7 of connected section.....	22.00
Heavy bedded limestone, lithographic and crystalline quarry stone; fossils, <i>Phillipsia</i> , <i>Euomphalus planorbiformis</i> , <i>E. (N. S.?)</i> , <i>Bellerophon carbonarius</i> , <i>Retzia vera</i> , <i>Pleurotomaria (Sp.?)</i> , <i>Terebratula bovidens</i> , <i>Rhynchonella mutata</i> , and <i>Athyris subtilita</i> , No. 8 of connected section.....	35.00
Chester chert No. 8.....	1.00
Limestone in thin strata; fossils, <i>Athyris ambigua</i> and <i>Syringopora</i> , No. 8.....	54.00
St. Louis chert, No. 9.....	2.00
Limestone.	
Total.....	<u>92.00</u>

The top member of the above section is very heavy, some

of the strata measuring over three feet in thickness. Stone has been taken from the quarry here for several years, and has been re-opened recently and some very excellent stone taken out. It was from this quarry that the stone for the foundation of the depot at Orleans was obtained. The experiment of burning lime from the lower member is being made with fair prospect of success.

SECTION NO. 8, LOCUST HILL, STAMPER'S CREEK TOWNSHIP.

Coarse-grained, even-bedded sandstone, No. 5.....	47.00
Shales, with bands of ochre, No. 5.....	13.00
Compact, crystalline limestone; fossils, <i>Archimedes</i> , <i>Pentremites pyriformis</i> , <i>P. Gordoni</i> and <i>Producta</i> , 2 sp., No. 6.....	17.00
Blue shale with ochre, No. 7 of connected section.....	8.00
Lower Chester limestone, No. 8.....	60.00
Total.....	<u>145.00</u>

SECTION NO. 9, AT ACRE SINKHOLE, STAMPER'S CREEK.

Heavy bedded quarry sandstone No. 5.....	10.00
Compact, massive limestone; fossils, <i>Productus cora</i> , <i>P.</i> <i>semireticulatus</i> , <i>Spirifer lineatus</i> , <i>Archimedes</i> and <i>Pentre-</i> <i>mites</i> , No. 6.....	25.00
Coarse sandstone, partly covered, No. 7.....	70.00
Limestone, with nodules of flint; fossils, <i>Euomphalus</i> and <i>Terebratula bovidens</i> , No. 8.....	40.00
Chester chert.....	1.00
Heavy bed limestone to S. C. Church, No. 8.....	45.00
Total.....	<u>191.00</u>

The lower Chester limestone here is filled with black flint nodules identical with those of the equivalent stone of Lawrence county, and the chert of this section, though nearly white, is of the same character. In fact, all the Chester cherts, wherever seen by us, have very much the appearance of a true flint or hornstone and with propriety might be called flint rather than chert.

On the top of the hill at this point is a remarkable cavity known as the "acre sinkhole." In shape it is almost perfectly round, and about 60 feet deep, with very abrupt sides, quite different from similar basins in the St. Louis formation.

These well shaped openings are not uncommon in the Chester. They are readily distinguished from true sinkholes by the absence of the chert, their more regular outline, abrupt sides, and the want of any central subterranean opening.

The upper sandstone, No. 5, in this township, is a very evenly stratified stone, of buff color, that is readily quarried by a little stripping, in blocks of fair length, and in thickness ranging from one to three feet. It makes excellent foundations for light buildings, such as barns and other wooden structures. It works easily and will weather well. Quarries have been opened on the Locust hill, on the land of Mrs. Clements and on the land of Henry Polson.

SECTION NO. 10, ALBERT'S HILL, PAOLI.

Massive sandstone: fossils, leaves and stems of <i>Stigmara</i> , No. 5, of connected section	30.00
Blue shales, No. 5	6.00
Crystalline limestone, with <i>Productus cora</i> , <i>P. semireticulatus</i> , <i>Pentremites pyriformis</i> , <i>Archimedes</i> , <i>Spirifer lineatus</i> , <i>Athyris subtilita</i> and stems of crinoids No. 6	16.00
Encrinital limestone, No. 6	14.00
Sandstone, No. 7	8.00
Decomposed limestone, local	12.00
Sandstone massive, No. 7	22.00
Crystalline massive limestone, No. 8	18.00
Lithographic limestone, No. 8	70.00
Total	<u>196.00</u>

The lower Chester sandstone, No. 7, which at many places is a shale of no value, is in the vicinity of Paoli an even-bedded rock, in some places of sufficient thickness to make a good quarry stone. East of town, Mr. Kibler has opened a quarry in which beds of stone measuring two and three feet thick are exposed. On the lands of Mr. J. C. Albert, section 25, township 2 north, range 1 west, is a quarry of a pretty tea-green stone, from which blocks of almost any required size can be taken. For flagging, these sandstones are very superior. Along the banks of Lick creek, the

lower Chester limestone has been found to be a good building stone. The rock used in the court house is from this horizon and demonstrates that when carefully selected it is a very excellent stone for foundations of heavy structures. It is probable that the lower strata will be found to contain less crystalline matter and fewer glass seams.

SECTION NO. 11, AT GASAWAY HILL.

Blue and red shales, No. 5.....	27.00
Sandstone flagging, No. 5.....	16.00
Limestone, with <i>Pentremites obesus</i> , <i>P. pyriformis</i> , <i>Poteroicrinus Bisselli</i> ? <i>Producti</i> and <i>Agassizocrinus conicus</i>	30.00
Soft sandstone	1.06
Blue shale.....	1.06
Yellow ochre06
Coal.....	.04
Soft sandstone, No. 7.....	12.00
Lower Chester limestone	42.00
Chester chert.....	1.00
Total.....	<u>121.10</u>

The above section is given to show the place of a thin coal seam that outcrops here and in the hills on the east. It has no fireclay beneath it, one of the essentials of a true coal bed. It is not likely that any of these coals will ever pay for opening, as no workable beds have been found below the Chester limestone.

SECTION NO. 12, AT ORANGEVILLE.

Massive sandstone, stained with iron ore	45.00
Middle Chester limestone, No. 6	19.00
Shaly sandstone, No. 7	18.00
Ochre, with a trace of coal and iron ore.....	1.00
Lower Chester limestone, with <i>Terebratula bovidens</i> and <i>Rynchonella subuneata</i> in lower members.....	95.00
St. Louis limestone to low water.....	30.00
Total.....	<u>208.00</u>

In the vicinity of Chambersburgh and Valeene and the southeastern part of the county, the Lower Chester is the prevailing limestone. It is exposed on the hill-sides and

in the valleys of Greenfield, Jackson, French Lick, Orangeville and Northwest townships, and is the only limestone of any economic value in these regions. Throughout the remainder of the county it retains the same characters that have been described as belonging to it, in the preceding pages.

At the farm of Mr. Kinley Osborn we were shown an argillaceous stone near the base of this stratum that seems to have hydraulic qualities. The bed is about eight feet thick and should be tested. An analysis could scarcely determine the quality of the cement it would make. Actual manufacture is the best method.

SECTION NO. 13, ON ROAD SOUTH OF FRENCH LICK.

Conglomerate sandstone, No. 3 of connected section...	45.00
Upper Chester limestone, with band of chert at the top ; fossils, <i>Archimedes Wortheni</i> , <i>Athyris Royissii</i> , <i>A. subtilita</i> , <i>Pentremites robustus</i> , <i>P. pyriformis</i> , <i>Spirifer lineatus</i> and <i>Producti</i>	15.00
Coarse sandstone, No. 5.....	35.00
Coarse grit, No. 5.....	20.00
Massive sandstone, No. 5.....	40.00
Blue shale, No. 5.....	12.00
Middle Chester limestone, No. 6.....	18.00
Sandstone and blue shales to Chester limestone.....	31.00
Total	<u>216.00</u>

Here we have the upper Chester sandstone well developed, and showing an average thickness. In it is found the true grindstone grits, and valuable building stone. Commercially, next to the whetstone grit, it is the most valuable stratum of stone in the county. In its upper members it generally shows the characters of the coarse grit, but it is only locally of sufficient firmness to be manufactured. The principal quarries are, Thomas N. Braxton section 25, Jonathan Lane and H. Lashbrook section 26, Wm. Lashbrook section 24, and J. Bledsoe section 13, all in township 1 north, range 2 west. The stone is quarried in large blocks and cut with a saw into slabs of the required thickness ; these, after marking, are broken into smaller pieces

and polished. The quarry of Mr. Braxton was formerly worked for grindstones, at present only "shoe rubbers" and scythe stones are made from it.

CONGLOMERATE OR MILLSTONE GRIT.

This epoch embraces the remaining territory not before noticed. It is principally confined to the north and west parts of the county. Where well developed, as in the north part, it is a mass of weather-worn rock, composed of quartzose pebbles, cemented together with coarse sand. In the central and southern part it loses its pudding stone appearance, and can only be distinguished from the other sandstones by its position above the upper Chester limestone. Locally it becomes a fine grained, compact grit stone:

SECTION NO. 14, TAKEN ON THE EAST SIDE OF THE HILL, AT THOS. N. BRAXTON'S WHETSTONE QUARRY.

Friable sandstone, No. 3.....	30.00
Coal, probably Coal A, fire clay not seen.....	1.00
Coarse sandstone, with <i>Stigmara</i> leaves and iron ore near the base.....	50.00
Whetstone grit, with <i>Lepidodendra</i> , <i>Calamites</i> , <i>Stigmara</i> , <i>Sphenopteris tridactylis</i> , <i>S. latifolia</i> , <i>Neuropteris</i> , and near the base <i>Paoli vetusta</i> , No. 3.....	21.00
Coal trace.....	.00
Coarse sandstone, locally glass sand, No. 3.....	40.00
Upper Chester limestone, with chert, partly covered	15.00
Sandstone and shales, No. 5.....	90.00
Middle Chester limestone, No. 6.....	20.00
Shales and sandstone.....	40.00
Lower Chester limestone, with a shaly parting near the top, to level of F. L. Spring.....	20.00
Total.....	<u>337.00</u>

The principal quarries that are worked in this vicinity are those of Thomas N. Braxton, section 5, township 1 north, sections 32 and 33, township 2 north; Wm. Able, section 32; George Reily, section 31; Lynch & Wolfington, section 29, and E. Pinnick, section 30, township 2 north; J. A. Moore, section 5, and S. Wolfington, section 4, township 1 north, all in range 2 west.

The ferns and other plants taken out of the lower members of fine grit are very fine. Specimens measuring two and three feet in length are not uncommon. We are indebted to Mr. John A. Bennett for a beautiful slab for the State collection.

SECTION AT DISHMAN'S QUARRY, SECTION 23, TOWNSHIP 3
NORTH, RANGE 2 WEST.

Conglomerated sandstone, with pebbles.....	45.00
Silicious iron ore.....	5.00
Massive sandstone, with <i>Stigmara</i>	20.00
Shaly sandstone.....	4.00
Whetstone grit, with shaly partings; fossils, <i>Neuropteris</i> , <i>Sphenopteris</i> , <i>Hymenophyllites</i> , <i>Lepidodendra</i> , <i>Knorria</i> , <i>Cordaites</i> , <i>Calamites</i> and <i>Lepidostrobus</i>	20.00
Shale.....	.04
Coal.....	.10
Fire clay.....	.06
Massive sandstone, locally white glass sand, and coarse grit.....	38.00
Upper Chester limestone, partly covered, No. 4.....	3.00
Covered space and sandstone, No. 5.....	70.00
Middle Chester limestone, No. 6.....	12.00
Total	<u>218.08</u>

At the quarry of Julius Lewis, in the same section as the above, the coal is said to be two feet thick.

This coal, and the plants found in the grit above it, has sometimes been referred to the Chester group. On the authority of M. Lesquereux and Prof. F. T. Cox, to whom was submitted a suite of fossils from these beds, we refer it and all the sandstones above the upper Chester limestone of our general section to the millstone grit epoch, which is doubtless correct. This places the whetstone grit of Orange county in the same horizon as the "Ouachita oilstone" of Arkansas, that which seems to be only an altered sandstone, the result of chemical action to which the stone under consideration has not been subjected.

The fine grits are everywhere very evenly stratified and may be split with great ease. After splitting to the required thickness the stone is scratched on the surface

with a piece of soft iron and broken into whetstones. Two different colored stones are quarried, white and buff. The first is known as "Hindustan" and the second as "Orange" stone.

The fossils of these beds are generally casts remarkably well preserved, showing the finest markings with great distinctness. The *Lepidodendra* are remarkable for size. We have a piece that formed part of a tree that was uncovered for twelve feet that measured four feet eleven inches in diameter. Specimens of the leaves are found over twenty inches long. The fossiliferous beds are not worked as the stone will not split. The fossils are scattered through it in every direction and not bedded as in the shales and in the French Lick quarries. The thin shaly partings that come out in large plates are ripple-marked and covered with tracks of crustaceans or some other animals. The *dendrites* here found are remarkable for size and beauty, and for running through the substance of the solid stone.

LACUSTRAL OR ALLUVIUM.

The fine impalpable sands and clays of the lacustral epoch are developed in considerable force in Northeast and Stamper's Creek townships, in what is locally known as "flat woods." It varies in thickness from five to twenty-five feet and covers an area of about twenty square miles, overlying the St. Louis limestone. This lake influence is also seen in producing the damp, impervious soils of Patoka river and in the vicinity of French Lick. Wherever gum and persimmon trees are indigenous to the soil, the fine sands of this epoch may be found.

The alluvial is well developed along the creeks and rivers of the northern and central parts of the county. In the valley of Carter's creek and Lost river are evidences of a much greater flow of water at some period than takes place now. In some places where the valley is nearly a quarter of a mile wide the sub-soil is a mass of gravel that has been brought from some place on the east. In the bank of the

river below where the old Maxwell mill stood is a bed of this gravel more than ten feet thick. Doubtless these beds were formed at the close of the lacustral epoch.

LOST RIVER AND CAVES.

The waters of Carter's creek and Lost river increase in volume in their course across the outcrop of the St. Louis limestones until, after uniting and forming Lost river, it strikes the eastern exposure of the concretionary limestone in section 4, township 3 north, range 1 east, where is formed the first sink; the second is in section 8; the third in section 13, township 3 north, range 1 west, and the fourth in section 11.

During summer and in dry weather, the first sink takes in all the water, leaving the balance of the channel dry from this place to Orangeville. Light rains will cause this sink to overflow, and very heavy continuous rains for twenty-four hours will carry the water over the whole length of the dry bed. The dry bed or channel extends from the second sink to Orangeville, and is the means by which the excess of rainfall that can not find passage under ground is carried off, thus preventing an overflow of the surrounding country. The subterranean channel is not a simple, straight, cavernous opening through which the water rushes, but a complex system of mains and leads, a counterpart of the surface drainage. Nor do these underground channels follow the course of the dry bed as might be supposed from there being frequent openings along its banks that connect with them. In sections 33 and 34, township 3 north, range 1 west, are three openings that we may designate as wet weather rises. Whenever the water is running into the fourth sink in force, it bursts out at the rises, so that we have water running through both the upper and lower parts of the dry bed, and none in the middle channel.

The dry bed is not an open channel, and has not the vegetal and timber growth common to the margins of streams, but is studded with majestic forest trees, and presents a wild and picturesque appearance when filled with

the rushing waters after heavy rains, which seem to be lost in the depths of the forest.

The underground stream may be reached at the fourth sink, where the cavernous opening is something like eight feet wide and four feet high. The descent is gradual and 590 feet long. The river comes to the surface at Wesley Chapel gulf, in section 9, township 3 north, range 1 west, where the superincumbent rocks have fallen in and forced the stream to the surface. The subterranean stream may also be reached at this point through a cave in the side of the hill. Some years ago a boat was taken in and the channel explored for some distance to a fall, beyond which it was impossible to pass.

A few yards to the northwest, in the same section, is a dry cave of considerable size, that has quite a local reputation for its numerous large and beautiful *stalactites* and *stalagmites*.

North and near Orangeville is another gulf or rise, where the water runs on the surface for some few yards and again sinks.

Orangeville is usually spoken of as the "rise" of Lost river, yet it is thought, and doubtless correctly, that the true rise of Lost river is on the farm of Robert Higgins, a mile or more further down the stream. Rains on the head waters of Carter's creek and Lost river do not affect the rise at Orangeville, but rains on Fulton's branch, that sinks in section 16, township 3 north, range 1 west, do, so that the water at Orangeville is rendered muddy and increased in volume. Yet we must think that Fulton's branch alone is insufficient to account for the whole of this rise, and it is probably fed by other underground streams.

Stamper's creek, in a small way, is a counterpart of Lost river, lacking the dry bed. It is thought that it again rises at the Spring mills and forms the source of French Lick. Saw-dust and other refuse from saw-mills situated on the banks of the creek have been worked out at the Spring mills.

The animal life of the caves and subterranean streams is much the same as that of the Mammoth and Wyandotte caves. In them have been found blind fishes, *Amblyopsis speleus*, *Potamacotilus Carolinensis*, seeing. Crawfishes: *Cambarus pellucidus*, blind, *C. Bartoni*, seeing; *Cæcidotea stygia*, *C. Packardii*, *Crangonyx vitreus*, *Euphilosia Elrodii*, and *Cauloæenus stygeus*, small crustaceans. Insects *Anthomyia*? *Anopthalmus tenuis*, *Platynus marginatus* *Cenothophilus Sloanii* and *C. subteranea*.

MINERAL SPRINGS.

French Lick and West Baden springs are situated on the west side of the valley of French Lick creek and break out through fissures in the lower Chester limestone. Springs are found scattered along the valley for about one mile. But as yet only those at French Lick and West Baden have been improved. Doubtless their origin is explained on the same principle that the waters of an artesian well become more or less impregnated with salts and gases dissolved by the water, in its passage, under pressure, through many different kinds of shale and stone.

The existence of these justly celebrated springs was early known, and are said to have been a place of resort held in high esteem by the aborigines.

They are pleasantly located in a picturesque region of hills, covered with their primitive forests of dense wild wood, affording a most delightful place of recreation during the heated term. At both places are excellent hotels, pleasantly situated on elevated grounds, well ventilated, with good rooms and supplied with every thing necessary to make guests and invalids comfortable. Attached to the hotels are the usual bowling alleys, croquet grounds, ball rooms, post offices, and in short everything found at a fashionable watering place. At present, French Lick is under the management of Dr. S. Ryan, and West Baden under that of Messrs. Noah Cook & Co.

For the information of those who may not have the Geological Survey of Indiana, 1870, in which are analyses

of these springs, by Prof. E. T. Cox, State Geologist, they are here repeated :

FRENCH LICK SPRINGS.

These springs break out in a multitude of places along the branch, each is claimed to possess special curative properties.

"A qualitative chemical examination at the fountain head, revealed that they all contained the same elementary constituents, but in varying proportions: Temperature of air, 92° F.; temperature of water, 56°. Numerous bubbles of sulphureted hydrogen and carbonic acid gas, mixed with oxygen and nitrogen gas, were continually escaping from the water. I succeeded in collecting a small quantity of this gas, which served for the analysis, the principal constituents being :

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

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

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

Carbonic acid.....	7.337
Sulphydric acid.....	6.717
Oxygen.....	5.407
Nitrogen.....	18.504
Total.....	<u>38.045</u>

Total solid matter in one gallon, 381.85 grains.

	Parts in 1,000,000, or pounds in 100,000 gallons.	Grains in one gallon.
Silicic acid.....	9.42	.6594
Oxide of iron.....	1.90	.1330
Lime	675.92	47.3144
Soda.....	1140.20	79.8140
Potash.....	41.72	2.9204
Magnesia	723.26	50.6282
Alumina	48.10	3.3670
Chlorine	1185.96	83.0172
Carbonic acid.....	690.55	48.3385
Sulphuric acid.. ..	845.55	59.1885
Iodides and Bromides.....	trace	trace
Total.....	<u>5362.58</u>	<u>375.3806</u>

The above constituents are probably combined as follows :

	Parts in 1,000,000, or pounds in 100,000 gallons	Grains in one gallons.
Silicic acid.....	9.42	.6594
Oxide of iron.....	1.90	.1330
Sulphate of lime.....	223.03	15.6121
Sulphate of soda.....	58.16	4.0712
Sulphate of potash	17.31	1.2117
Sulphate of magnesia.....	954.41	66.8087
Sulphate of alumina.....	85.46	5.9822
Carbonate of lime.....	574.00	40.1800
Carbonate of soda.....	68.52	4.7964
Carbonate of potash	47.48	3.3236
Carbonate of magnesia.....	753.00	52.7100
Chloride of calcium.. ..	470.04	32.9028
Chloride of sodium.....	2027.04	141.8928
Chloride of magnesia.....	72.81	5.0967
Iodides and Bromides.. ..	trace	trace
Total.....	<u>5362.58</u>	<u>375.3806</u>

WEST BADEN SPRINGS.

These springs are about one mile north of French Lick springs. Here, also, the sulphur water breaks up in a great many places. I made at the fountain head a qualitative analysis of the three that were most used and found

in all the same elementary constituents. Temperature of air, 93° F.; temperature of water 55°. A whitish slimy deposit is formed on the gum, mostly sulphur, with some oxide of iron:

Free gases. Sulphydric. Carbonic acid. Oxygen. Nitrogen. Sulphuric acid. Hydrochloric acid. Carbonic acid. Soda. Potash. Lime. Magnesia.

I could spare only the time to analyze one, and selected for the purpose the water from the spring with a stone curbing as it appeared to be the most frequented:

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

Carbonic acid.....	6.198
Sulphydric acid.....	5.931
Oxygen.....	2.093
Nitrogen.....	6.572
Total.....	<u>20.794</u>

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

	Parts in 1,000,000, or, Pounds in 100,000 Gals.	Grains in one Gal.
Silicic acid.....	7.50	.5250
Oxide of iron.....	1.50	.1050
Lime	539.11	37.7377
Soda.....	765.26	53.5682
Potash	19.37	1.3559
Magnesia.....	610.76	42.7532
Alumina.....	43.50	3.0450
Chlorine	779.26	54.5482
Carbonic acid.....	675.21	47.2647
Sulphuric acid.....	601.30	42.0910
Iodides and bromides.....	trace.	trace.
Total.....	<u>4042.77</u>	<u>282.9939</u>

The above constituents are, probably, combined as follows :

	Parts in 1,000,000, or, Pounds in 100,000 Gals.	Grains in one Gal.
Silicic acid.....	7.50	.5250
Oxide of iron.....	1.50	.1650
Sulphate of lime.....	191.70	13.4190
Sulphate of soda.....	53.28	3.7296
Sulphate of potash.....	23.48	1.6436
Sulphate of magnesia.....	619.83	43.8881
Sulphate of alumina.....	77.28	5.4096
Carbonate of lime.....	709.43	49.6601
Carbonate of soda.....	19.08	1.3356
Carbonate of potash..	10.71	.7497
Carbonate of magnesia.....	671.48	47.0036
Chloride of calcium.....	124.78	8.7346
Chloride of sodium.....	1337.18	93.6026
Chloride of magnesium.....	195.54	13.6878
Iodides and bromides.....	trace.	trace.
Total.....	4042.77	282.9939

OTHER SPRINGS.

On the west side of the valley of French Lick creek, between French Lick and West Baden, are three excellent sulphur water springs, owned by Mr. John C. Albert. Another spring breaks out in the bank of Lost river, on the farm of Nathan Lamden, and also a spring on the farm of Mr. Robert Higgins, about one mile south of Orangeville. None of these springs have been improved.

On the lands of Maj. D. S. Huffstetter, near Orleans, is a chalybeate spring of considerable local repute, that deserves a careful analysis.

As it takes many days to make a correct analysis of mineral water it was too late in the season when we commenced work to have any made for this report. And hence, we did not collect any water this year, as it should be as nearly fresh as possible at the time of making the analysis.

ECONOMIC GEOLOGY.

So little has been done in the way of prospecting for and opening the coal seams in the western part of the county

that but little can be told of their extent and value. Enough is known to justify us in saying, that two seams of coal are found in the county, the upper one of which is of some economic value; we refer to coal "A" of Prof. E. T. Cox, in his Indiana classification. This coal is found in all the higher hills along the western part of the county. The locality in which to make search for the coal is immediately above the heavy conglomerate sandstone overlying the whetstone grit. The outcrop of this coal is seen near the top of the hill on the land of Mr. Thos. N. Braxton, section 32, township 2 north, range 2 west.

So far as this coal has been examined, it seems to be a semi-block or dry coal, is too dry and burns too loosely to make a first class smithing coal. At the place named, and in all the higher hills to the west of French Lick, it would be advisable to search for and mine this coal for local use.

On the land of Mr. Charnes, section 8, township 1 north, range 2 west, and on the line of survey of the proposed Rockport & Mitchell railroad, near the south line of the county is found and has been mined, a sub-conglomerate coal which in these places is a true block coal, and thirty inches thick. This coal may be searched for about thirty to forty feet above the upper Chester limestone, and but a feet below the whetstone grit. Farther north, it thins out to such an extent as to be entirely worthless. Besides these two seams, which may in many parts pay for developement, there is another Chester coal in this county on which some labor and money has been spent but which can not in any place pay for mining, as it is only from one to four inches thick. It is located just above the lower Chester limestone, and is exposed at many places in the county, the most noticeable is on the land of Mr. Gasaway, one mile north of Paoli. In the central and eastern parts of the county is found a thin seam of cannel coal, in the St. Louis limestone, and it is our duty to advise that no money be expended in prospecting for it, as it can not possibly prove of any commercial value.

IRON ORES.

The hydrated brown oxide of iron, found in the conglomerate above the whetstone grit, is of great importance. It is found in all the hills in the western part of the county. In some localities it is comparatively free from silica. An analysis of selected specimens, obtained from section 8, township 1 north, range 2 west, have proven to be very rich, containing over fifty per cent. of metallic iron. This ore has been mined to a considerable extent in Lawrence county, and smelted at the blast furnace at Shoals, making, in combination with the Missouri ores, an excellent neutral iron. This ore is from three to ten feet in thickness, and will, when the proper facilities of transportation are completed, justify the erection of blast furnaces at many points along the western boundary of the county.

WHET-STONES AND GRIND-STONES.

One of the most important minerals of this county is the long celebrated Hindoston stone, or what is known as the whet-stone grit, being unsurpassed by any in the world as a water stone, even in texture and fine grained. From this stone is manufactured ax stones, carpenter stones and "slips." The principal manufacturers are Thos. N. Braxton, near French Lick, and Louis Chaillaux, who is manufacturing for Mr. F. E. Dishman, in the northwest corner of the county.

The geological horizon of these quarries is indicated in the general connected section of the county. The following local section is taken at Braxton's quarry, in section 5, township 1 north, range 2 west:

	Ft.	In.
Stigmara sandstone	7	00
Hard sandstone with shaly partings.....	3	00
Shale	0	06
Whetstone grit.....	1	06
Shale	0	10
Whetstone grit.....	2	10
Shale	0	10
Workable whetstone grit.....	2	10

Shale	0 06
Whetstone grit.....	2 10
	<hr/>
Total	23
	<hr/>

The stone is quarried and broken into proper form and size, and finished by steam power.

At Dishman's quarry we have the following section. It is located in section 23, township 3 north, range 2 west :

	Ft.	In.
Stigmara sandstone.....	6	00
Shaly sandstone.....	4	00
Whetstone grit with shaly partings.....	20	00
Shale	0	04
Coal	0	10
Fire clay.....	0	06

At this quarry is also steam works, with a capacity to finish about six hundred boxes per year.

Besides these mentioned, there are several more quarries where the finishing is done by horse power.

The demand for these stones increases with facilities for manufacture, and large invoices are shipped to Sheffield, England.

The Hindostan grindstone grit of this county is justly celebrated. It is of uniform texture and keen bite; of sufficient solidity to adhere together under any rate of speed that may be necessary. Grindstone quarries have been worked in various parts of the county. The geological horizon of the grindstone grit is lower than the whetstone quarries, being in the Chester group, just above the middle Archimedes limestone.

The most extensive quarry of this stone is worked by Mr. Thos. N. Braxton, on section 25, township 1 north, range 1 west, from which he is manufacturing shoe rubbers and scythe stones. Owing to their freedom from glazing, there is no better stone for these uses. For the same reason, this stone would make an excellent grindstone to work dry. We indicate the position of this stone in the connected section in No. 5.

BUILDING STONE.

Good limestone and sandstone, suitable for building purposes, is found in great abundance in the county. One member of the lower Chester limestone, furnishes, in many parts of the county, a good, fine grained, and easily worked stone, which is white as alabaster. This is quarried at the sand hill near Orleans; is exposed on the road from Orleans to Paoli, two miles south of the former place, and found on the lands of Benjamin P. Chatham and James A. Frost, section 5, township 2 north, range 1 east.

As mentioned elsewhere in this report, the lower Chester sandstone is sometimes a good quarry stone. It is found to be so in the vicinity of Paoli, at the quarry worked by John C. Albert, on section 25, township 2 north, range 1 west. The stone is of a light, tea color, the upper members making a superior flagging stone, and the lower a good building stone; is easily quarried and readily worked.

LIME.

There are some members of the St. Louis limestone, in the eastern and central portions of the county, that make good lime, but the best of lime is made from the lower Chester. This was formerly worked extensively on Lost river, near West Baden, in French Lick township, and shipped to the southern market by flat boats. A kiln is now being erected on the hill northwest of Orleans, in which to burn this stone into lime.

CLAYS.

A fine lacustral clay abounds in the northeastern part of the county, which has been manufactured into stoneware of a very good quality, at Lancaster, on the L. N. A. & C. railroad. It could be worked to good advantage into roofing or drain tiles. We find *Kaolin* in the county, but as yet not in quantities to render it of any commercial value. Samples of good *Indianite* have been picked up on the land

of Mr. O. Burnett, section 20, township 3 north, range 1 west. A three feet stratum of a very fine yellow ochre is exposed on the land of Mr. Freeman, section 7, township 1 north, range 2 west.

AGRICULTURE.

The topographical features of this county are quite varied, being determined by the outcrops of the various geological formations within its limits, and we find a corresponding variety in the nature and fertility of the soils. As but few of the hills and ridges reach above the upper Chester limestone, all the essential elements necessary to produce a good soil, are well proportioned. The addition of calcareous matter, derived from the limestones, furnishes the necessary material to render the soil mellow and warm, and supply elements which give to the soils of this county more than average fertility and renders them quite superior to the arenaceous lands destitute of lime. The St. Louis limestones, Chester sands, and Lacustral clays are the principal divisions. The calcareous lands are all very fertile, with a subsoil of red clay resulting from the admixture of oxides of iron and associated minerals. In this respect they are very different from the white or colorless clays of the chert region of some of the other States. The Chester sands are, as a rule, warm and mellow, producing heavy growths of timber, corn and the other small grains. The Lacustral lands are heavy, alternating blue and black clays, largely intermixed with fine sand, rendering it close and rather cold for corn and wheat, without better drainage. Yet good crops are produced by planting on the top of the over-turned sod and shallow cultivation, so that the decaying sod may act as an underdrain. These soils are *par excellence* the grass lands of the county. On them timothy and red-top grow luxuriantly; clover does not do so well, freezing out in a year or two. Doubtless these heavy soils would be much improved by under-draining. They are the same kind of clays as those of Jefferson county, mentioned

by Prof. W. W. Borden, in Geological Survey of Indiana, 1874, as so signally improved by drainage. We think the trial has only to be made to demonstrate its utility.

This county is well adapted to sheep raising, especially in the hilly portions that can not so well be planted with the cereals. All the streams and brooks of the valleys are bordered by bottom lands, which, if put in grass, would furnish an abundance of winter feed, while the hillsides will produce good pasturage for summer use. Water for stock is everywhere abundant. Especially do these remarks apply to the south part of the county. It is not better soil that is wanting, but better culture.

In traveling over the county, we noticed several considerable bodies of land that were badly washed. The remedy for this might be found in setting them with grass. From experiments made by Mr. J. C. Albert, on the hill east of Paoli, blue grass will succeed well on the soil derived from the Chester sandstones. To get a good and quick set, it should be sown on a virgin soil, and it is said that under proper management and pasturage, it will improve for thirty years.

Some of the finest fruit regions of the State are the chestnut hills of the central, and the sandstone ridges of the western and southern portions of the county. The experiments of Messrs. Fletcher Mavity, Wm. Martin, J. H. Lindsey and others demonstrate this fact. The warm, sandy soils are peculiarly adapted to the growth of peaches, very much improving them in flavor, size and color.

The abundant and luxuriant growth of the summer grape (*Vitis aestivalis*) on the hillsides and uplands, and an equally abundant growth of the winter or frost grape (*Vitis cordifolia*) on the low lands, together with occasional vines of the fox grape (*Vitis labrusca*) may be regarded as a certain indication of the adaptability of the soil to the cultivation of improved varieties of grapes. The Catawba and Isabella grapes have been grown with success, and doubtless the Concord, Delaware and other recent varieties will be found equally well adapted to the

soil and climate. The chert lands north and west of Orleans will be found excellent land on which to grow plums and other fruits that are liable to be attacked by the curculio.

TIMBER.

The varieties of timber found in the county being determined by the soils, may be divided into districts corresponding to the geological group into which the rocks are divided, each being characterized by some peculiarity, either of growth or species, yet having many trees in common that seem to be adapted to all the kinds of soil.

In the region of country underlaid by the St. Louis limestones, formerly there was a heavy growth of that monarch of our forests, the yellow poplar (*Liriodendron tulipifera*). Next in size and exceeding it in commercial value comes the black walnut (*Juglans nigra*). Before these two trees had been so much cut away, it was not uncommon to see logs of the former that measured five feet, and of the latter four feet in diameter. The following are common and of good size: white walnut (*Juglans cinerea*), sugar maple (*Acer saccharinum*), red maple (*A. rubrum*) buckeye (*Æsculus glabra*), hackberry (*Celtis occidentalis*), slippery or red elm (*Ulmus fulva*), American or white elm (*U. Americana*), nearly always called red elm here, shellbark hickory (*Carya olba*), mockernut (*C. tomentosa*), thick shell-bark hickory (*C. sulcata*), pig-nut (*C. glabra*), white oak (*Quercus alba*), red oak (*Q. rubra*) jack oak (*Q. imbricaria*), burr oak (*Q. macrocarpa*), black oak (*Q. nigra*), chinquapin oak (*Q. obtusiloba*) white ash (*Fraxinus Americana*) and wild cherry (*Prunus serotina*). Along the streams are a few sycamores (*Platanus occidentalis*), and water beech (*Carpinus Americana*). The undergrowth is remarkable for size, so that the woods present a very open appearance even in the wildest places. This growth is made up principally of dog-wood (*Cornus Florida*), red bud (*Cercis Canadensis*), crab apple (*Pyrus coronaria*), sassafras (*Sassafras officinale*). The shrubs are spice bush (*Lindera benzoin*), wahoo (*Euonymus atropurpureus*), and

paw-paw (*Asimina triloba*.) In the cherty and more rocky parts there is an increase of small timber and shrubs and the undergrowth very dense. Here we find the wild *Pyrus Americana*, hawthorns (*Crataegus coccinea*) (*C. tomentosa*), black haw (*Viburnum prunifolium*), and hazel (*Corylus Americana*.)

The timber found growing in the Chester sands includes yellow poplar, black and white walnut, the oaks, hickories, cherry and ash of those enumerated above, and in addition, beach (*Fagus ferruginea*), American aspen (*Populus tremuloides*). On the high ridges are fine specimens of chestnut (*Castanea vesca*), and in the open ground persimmon (*Diospyros virginiana*). In this region the growth is vigorous, and yellow poplars are very common. The warm sands seem well adapted to the growth of this tree, and dealers claim that the lumber made from it is superior to that from timber grown in the bottoms. The black oak, in bodies, is confined to the conglomerate formation, where the barrenness of the soil shows its influence, especially on the young hickories. Yet even here, the yellow poplars and white oaks grow to be giants, but not in so great numbers as in more favorable localities. In the lacustral clays we saw a few specimens of sweet gum (*Liquidambar styraciflua*). The beech is very peculiarly adapted to these heavy soils. In Stamper's Creek township, we saw whole groves in which the yellow poplar never grows. Among the rare trees we heard of a single cucumber tree (*Magnolia acuminata*), and saw a few winged elms (*Ulmus alata*).

ANTIQUITIES.

There are in Orange county many evidences of its having been at one time thickly populated by pre-historic man. Arrow heads, spear heads, axes and stone ornaments are found in considerable quantities throughout the county. Especially are these abundant in the vicinity of springs and streams. One mile east of Paoli, on the south bank of Lick creek, is the remains of the enclosures of a village, with many kitchen mounds within and surrounding it. The

enclosure proper is about twelve hundred feet in circumference, surrounded by a double earthwork. Within the enclosure are twelve mounds, from one to two and a half feet high, eight feet in length by about four in width, the longest diameter being from northeast to southwest. Without the walls are a number of similar mounds upon the margin of the stream. These mounds we judge to be only kitchen mounds, or the sites on which the wigwams of the inhabitants stood.

On the farm of Floyd McCoy, in Stamper's Creek township, are found a number of small burial mounds, built of a red clay which has been carried from the hills surrounding the bottom on which they are situated. On the land of Major D. S. Huffstetter, surrounding a chalybeate spring, are found numerous arrow heads, likewise at the rise of Stamper's creek.