CHAPTER X.

COAL BEDS OF SOUTHEASTERN IOWA.

The counties of this district which produce coal lie partly along the eastern margin of the Iowa coal field, partly within the most productive area of the region, and partly on the border of the Upper Coal Measures. In the eastern half of the district the Lower Carboniferous limestones are exposed in the beds of all the principal streams and occasionally even in the uplands. In the extreme southeastern portion still lower members of the Lower Carboniferous are shown — the upper portion of the Augusta beds as far down as the upper part of the Burlington limestone. Eastward the Coal Measure strata thin out and pass into isolated outliers. To the westward the most productive part of the Coal Measures come to lie deeper and deeper until in the westernmost counties they are at depths of three to four hundred feet below the present surface of the ground.

The counties included in the district of southeastern Iowa are: Keokuk, Lucas, Monroe, Wapello, Jefferson, Wayne, Appanoose, Davis, and Van Buren.

KEOKUK COUNTY.

This county lies along the eastern margin of the coal field, and the Coal Measure strata are consequently comparatively thin. Nevertheless, this region ranks among

the more important coal producing districts of the state. Fully one-half of the county is underlain by coal bearing layers which have been proven to contain a relatively large amount of workable coal.

The northeastern half of the county is occupied almost entirely by the Lower Carboniferous limestones. These are also well exposed at short intervals along the larger streams from the east to the west county lines. These limestones form the basement upon which the Coal Measures rest, and they manifestly lie at no very great depth from the surface even in the western part of the county. The principal portion of the limestone found is the uppermost member of the Lower Carboniferous, the Saint Louis formation. The Augusta limestone, including both the Burlington and Keokuk formations, appears to be well represented in the eastern part of the region.

The Saint Louis rocks, however, are by far the most important of the beds making up the Coal Measure basement. The surface is very uneven, having a relief not unlike the present topography of the county even where it underlies the Coal Measures. The character of the irregular surface of the Saint Louis limestone has been fully described in connection with remarks on the adjoining counties. Yet there are some particular features shown in Keokuk county which deserve special attention. Like in the neighboring counties there are wide ridges and valleys, many of considerable extent, with minor ones opening into them in all directions. With the broken relief of the surface when the Coal Measures were laid down the latter were allowed to accumulate in unusual thickness in places. Were it not for this fact no coal would now be preserved within the limits of the county. Under other conditions the limestones would be too near

the surface and the drift would be too deep to allow the preservation of much of the Coal Measures. Under the existing circumstances there are numerous basins which, though limited in many cases, are in a few quite extensive, affording good deposits of coal. One of the most notable seams is in the What Cheer district. There are probably also outliers of Coal Measure strata in different parts of the county, but only in a few cases have they been definitely located.

The principal mines of the county are situated in the neighborhood of What Cheer, in the northwestern corner. At this point an important mining industry has been developed during the past few years, and some of the largest and best equipped mines in the state have here been

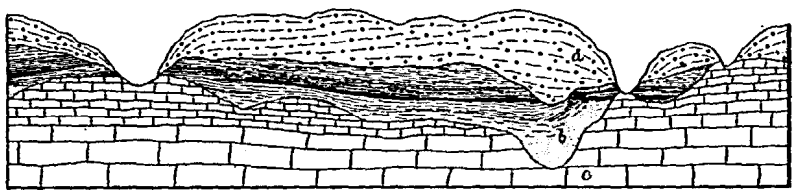


Figure 140. Ideal Cross Section through the What Cheer District from Rock Creek to the North Skunk River.

opened. The character of the formations at this point would at first glance not seem to warrant the great mining activity which at present exists. Eastward within two miles of the town the Saint Louis limestone outcrops on Rock creek, where it has been quarried. It is also known to occur at the surface within six miles to the west and the same distance to the south. The known outcrops of the neighborhood and the borings which have been made in the district show very clearly that the Coal Measures at this point occupy a considerable depression in the limestone, the basin having approximately an area of forty to fifty square miles. The relations between the

two formations are graphically represented in figure 140, an ideal section through the Coal Measures in a southwesterly direction from the old quarry on Rock creek to the North Skunk river. Between Rock creek and Coal creek is a small basin in which lies the coal worked in the Armstrong mine. In the bed of Coal creek the limestone was formerly exposed and is shown in the section. It probably represents a hummock protruding through the coal rather than a ridge entirely separating two basins. West of this is the coal worked in the What Cheer No. 1, which is cut out farther west by a sandstone "fault." South and west of here the limestone is known to lie much deeper, probably on account of more profound erosion. Beyond, the conditions seem to have been favorable for coal deposition, though the limestone is again exposed at the surface in the valley of the North Skunk. To the south and west there appears to have been a large bay or series of basins in which most of the Mahaska county coal was laid down. While coal in the What Cheer area may not be found over all of the basin, and while in places it may not be at present available, owing to the drift lying immediately over it, the seams are sufficiently thick for profitable working over a considerable portion of the area. The vein worked lies about thirty-five feet above the limestone, and from twenty to one hundred and twenty-five feet below the surface, according to the surface relief. It is underlain by fire clay, five or six feet thick, and is covered by a thick band of black, fissile shale which is said to reach in places a measurement of several feet.

The phenomena observed in regard to the lithological characters and the arrangement of the beds seem to indicate that the conditions under which they were formed were manifestly quite favorable to the accumulation of

the coal forming material; yet not sufficiently uniform and undisturbed to allow the formation of a perfectly continuous layer. In one place local disturbances allowed an influx of clay sediments during the deposition of the coal. This is well shown in a ridge of bony coal in the What Cheer No. 4. Again ridges and spurs of clay or sand material run out into the coal basin as noted just west of the Black Diamond mine. Low hummocks or ridges of underlying limestone protrude through the coal in several places. Thus, in driving an entry in the Armstrong mine a bench of the Saint Louis limestone was encountered.

Since the formation of the coal in Keokuk the strata of the district have been subjected to considerable erosion. Agencies of this character have also co-operated in interrupting the continuity of the seams. Channels of greater or less extent are found cut directly out of the coal beds, carrying also portions of the underlying layers. One of these ancient gullies, now filled with sand and shale, has been noted in the What Cheer No. 5. It is represented in figure 141, in which the coal is cut off abruptly, and the space occupied by sand. The face of the coal in contact with the sand is badly weathered for a distance of several inches. The following is the section of the coal seam:

		FEET.	INCHES.
3.	Shale, black, fine grained, fissile.....	2	
2.	Coal, fine, even textured	6	6
1.	Fire clay, fine, gray		6

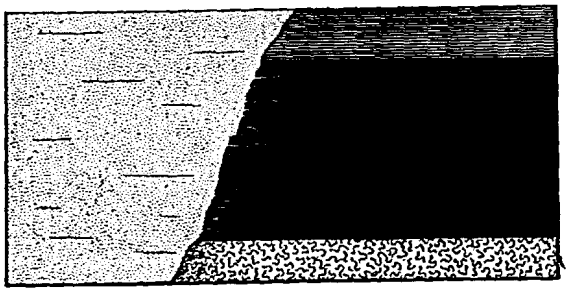


Figure 141. Seam at What Cheer Mine No. 5. Coal cut out through Erosion. What Cheer.

Despite of all the modifying conditions mentioned and the inherent improbability of any very extensive coal deposits so near the margin of the coal field, a very considerable amount of the mineral has been already found and large quantities mined.

The principal operations in this district have been carried on by the What Cheer Coal Company. Five large and important mines have been opened, two of which (Nos. 2 and 3) have been entirely worked out. No. 1 is located a mile south of the town of What Cheer (Tp. 76 N., R. XIII W., Sec. 15, SW. qr., NW. ¼); Nos. 2 and 3 are about two miles northwest of town; No. 4 about two miles directly north (Tp. 76 N., R. XIII W., Sec. 3, NW. qr., NW. ¼); and No. 5 half a mile still farther to the west. For several years past all of these mines have been worked on a large scale, and they may be regarded as among the most important in the state. A quarter of a mile northeast of the What Cheer No. 1, on Coal creek, is the Armstrong mine. The coal is of about the usual thickness and in places is within twenty or twenty-five feet of the surface. Between the two mines the Saint Louis limestone lies in a narrow ridge and was formerly exposed and quarried near by on Coal creek. A mile east of the What Cheer No. 3 is the Black Diamond, a small mine which is about forty feet in depth. In the same vicinity is the old Smith and Rowley mine. The Crescent Coal Company has opened important mines in this district; the Vulcan (No. 2) is a mile northwest of the What Cheer No. 5 (Tp. 77 N., R. XIII W., Sec. 33, SW. qr., SW. ¼); and No. 3 half a mile west of the What Cheer No. 4. The company has recently located a body of coal a short distance west and are making preparations to open it. Half a mile northeast of the What Cheer No. 5 is the

shaft called the North Star, which supplies considerable coal for local trade. Two miles directly north of the latter is the Pioneer mine, opened by a company at Thornburgh. This company formerly operated a small local mine but recently sunk a new shaft a short distance north of the other one, and are now getting out considerable coal. The section shows:

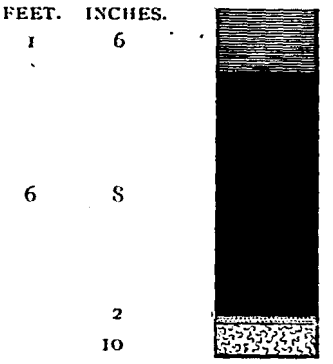


Figure 142. Coal Bed at Pioneer Mine. Thornburgh.

Many other mines have been opened in the vicinity of What Cheer, or have been opened from time to time between What Cheer and Thornburgh, but most of these are now deserted. Among the principal ones were the Keystone, Morgan, Blancquardt and Carroll mines. Directly east of What Cheer the coal is near the surface and is reached at several points by means of slopes.

Six miles directly south of What Cheer is the town of Delta. Two miles south of this place on the North Skunk river is an exposure of coal, while both up and down the river the Saint Louis limestone outcrops. The Coal Measures here apparently lie in narrow troughs. Several openings have been made in this vicinity (Tp. 75 N., R. XIII W., Sec. 13, SE. qr., NE. $\frac{1}{4}$). The coal lies a short distance above the river bed and is reached by drifting

from the valley. The seam is from three to three and one-half feet in thickness, and is covered by a black shale. The mines are local; the two principal ones being the Fisher and the Hickman & Chandler.

North of Sigourney, the county seat, a small coal seam has been encountered and has been worked to some extent by drifts. The vein lies along Bridge creek, about two and a half miles from the town. Several openings have been made, but only one, the Rowley (Tp. 76 N., R. XIII W., Sec. 23, SE. qr.) is now in operation. The same coal has also been reached by means of a shaft from the top of the hill. The coal is from three to four feet in thickness. A section measured in the opening is as follows:

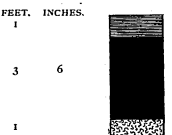


Figure 143. Coal Bed at Rowley Mine. North of Sigourney.

This mine supplies coal for only local use.

Near Richland, in the southeastern part of Keokuk county, is a small coal field apparently more closely connected with the Jefferson county area than with either that of Washington or the remainder of Keokuk county. The coal lies at a depth of about eighty feet. The greater portion of the covering is drift, only a few feet of a light shale being found over the coal. It usually runs from three and a half to five feet, but in places is only four inches thick or thins out altogether. It is apparently distributed in small basins of no great extent. The coal is

of fair quality and in the main of good workable thickness, but it is quite irregular in its distribution and usually has a poor roof. These difficulties make the mining a matter of considerable extra expense, and were it not for the lack of competition and the resulting high price, the coal could probably not be taken out profitably. A number of local mines have been opened here, but only two, the Smith and the Cordis, are now working. Both supply considerable coal for local trade. The Smith mine is located about four miles south of Richland (Tp. 74 N., R. X W., Sec. 31, SE. qr., NE. $\frac{1}{4}$) near the old Rambo mine. The coal averages four feet in thickness. The roof is a gray clay shale from six to ten feet thick and requires considerable timbering. The section seen in the mine is:

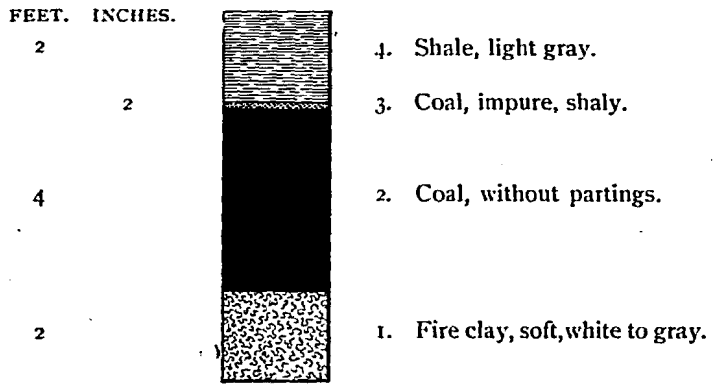


Figure 144. Seam in Smith Mine. Richland.

The coal is more or less undulatory and shows in places step faults with a total displacement of six feet or more. A few clay seams and one or two "pinch outs" have been met with. The latter are in no case of great extent.

Near this mine a number of deserted mines exist. It is customary in this field to work only a small area from each shaft and when any difficulty is encountered the

mine is abandoned and a new one opened. In this way as many as five shafts have been sunk on a forty acre tract.

About one mile east of the Smith mine is the Cordis mine, which is on a branch of Richland creek. This mine works in coal similar to that at the Smith mine and probably belonging to the same coal horizon. The roof here is of the same character and the coal from three to four feet thick. The fire clay under the coal here is said to be fifteen feet in thickness. In the vicinity are also many abandoned mines.

In the southwestern portion of the county coal is said to occur at a few points. It has been encountered about one and a half miles northeast of Fremont at a depth of 154 feet, but has never been worked.

LUCAS COUNTY.

Lucas county formerly contained the largest and deepest mines in the state. It was in this county where the first and almost only successful experiments in regard to the nature and capabilities of Iowa coal were carried on extensively. These investigations were made by the Whitebreast Coal Company, which operated largely in this county. The experiments were made with special reference to the determination of the adaptabilities of the various varieties of coal, the coking properties and the utilization of slack and coal dust. In regard to the latter, briquettes were manufactured in various ways, but it was found that with the methods used the coal dust could not be economically compressed and cemented for commercial purposes.

No Lower Carboniferous limestones are exposed at the surface within the limits of the county. They have,

however, been reached at different points in boring and are known to lie at depths of from 300 to 400 feet or more from the surface. They present the same irregularities of the surface as are developed at other places where the Coal Measures are very much thinner. At Cleveland and Lucas, in the western part of the district, the limestone has been encountered at one point at a depth of 300 feet.

The drift of this county, though having a considerable thickness over most of the area, is apparently not so great as it is known to be in some of the adjoining counties.

The stratified rocks immediately underlying the drift belong entirely to the Coal Measures, by far the greater part of which is the lower division. Along the western margin of the county the Upper Coal Measures have been recognized in a few places. Several coal horizons have been recently found in Lucas county. In general there appears to be a zone of horizons near the surface. These are exposed east and north of Chariton and in the northeastern corner of the county. Another horizon is about 250 feet below, which yields a much greater amount of coal. The seam varies in thickness from one to seven feet.

Whitebreast Valley.—The most extensive developments of the lower Coal horizons have been made along Whitebreast creek in the western part of the county where the seams are a considerable distance beneath the surface. The mining industry of the county has been carried on more vigorously near Cleveland and Lucas than anywhere else. In this locality four and in some places five seams of coal are known to occur. The first is very thin and often absent in many places on account of preglacial erosion. A short distance below this one is

a seam of rather poor quality. It is about eighteen inches in thickness. At a depth of from sixty to eighty feet there is a third vein of coal varying from eighteen to thirty inches in thickness, with an average of about two feet. This coal is well shown in the Lucas and Cleveland mine, where the section is:

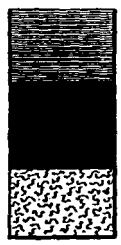


Figure 145. Coal Bed at Lucas and Cleveland Mine. Cleveland.

The coal is of very good quality and while the seam is somewhat irregular it has been worked with profit at a number of localities. Below this, at the depth of from 270 to 300 feet from the surface, is the vein which has been the principal one worked in the district. The coal is from three and one-half to seven feet in thickness. The roof is a rather soft shale and consequently not very good in places. Another thin seam has been found below this one, while thirty-five feet below the principal seam the Saint Louis limestone has been encountered at certain points.

The Whitebreast Coal Company formerly operated three large shafts in this region which were at one time the most extensive and best equipped mines in the state. No. 1 was near the town of Lucas (Tp. 72 N., R. XXIII W., Sec. 13, SE. qr., NE. $\frac{1}{4}$); while Nos. 2 and 3 were about five miles farther west. These mines were operated for several years and during that time large quantities of

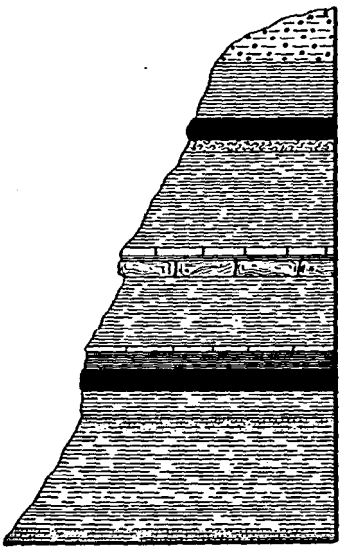
coal were taken out. The combined annual output at one time was nearly half a million of tons.

About half a mile northwest of the Whitebreast No. 1 is the old Chariton mine. Half a mile southwest of the same mine is the Eikenberry shaft; while about the same distance still farther in the same direction is the new Lucas shaft where, though down 300 feet to the lower coal, only the upper seam is at present mined. The Whitebreast mines have been abandoned for some time and the top works removed. Recently the Cleveland Coal Company has purchased No. 1 and is now engaged in taking out the upper coal.

From Cleveland down the valley to the county line numerous outcrops are found in the bluffs. They have been worked by drifts for many years, but at the present time comparatively little mining is being carried on. The seams are similar and perhaps identical with those exposed still farther down the creek, in Warren and Marion counties. In the former, one of the most important seams was called at one time after the town of Lacona not far from the Lucas county line. A mile below Cleveland several small mines have been opened at various times and a little coal is now taken out during the colder months of the year. Four miles to the northeast there are two seams of coal exposed in the bluffs at several points. St. John's section taken at Wheeler mill is essentially the same as that now exposed, though at the present time the outcrop is somewhat obscured. It is shown in figure 146.

Several other exposures are met with between here and the confluence of the creek with the Little Whitebreast where a seam has been mined to some extent. The coal is rather poor, but has a thickness of from two to three feet. It is said to be exposed at several points in

the bed of the creek. Eight miles northwest of Cleveland, in the valley of English creek, coal has been mined but not extensively. It is also exposed in the bluffs of



		FEET.
12.	Drift	5
11.	Shale, argillaceous, variegated	4
10.	Coal	1½
9.	Fire clay	1
8.	Shale, variegated	8
7.	Limestone, impure, earthy in places.	2
6.	Shale, ash colored, calcareous below	6
5.	Limestone, bluish, nodules in places	⅔
4.	Shale, black, bituminous, fissile	1½
3.	Coal	1½
2.	Fire clay	2
1.	Shale, light colored, sandy in places.	10

Figure 146. Section on Whitebreast Creek. Five Miles Northeast of Cleveland.

the same stream. It is about eighteen inches thick and is covered by a stratum of black shale of about the same thickness.

Little Whitebreast District.— Coal has been mined in a desultory manner along this creek for a long time. The present groups of openings are a few miles north and a few miles east of Chariton. No deep mining has been done. The coal mined is quite near the surface and crops out at short intervals along Little Whitebreast and its tributaries. Two seams of coal have been opened at different times. These have been drifted into at numerous points, but shallow shafts are now used. The upper vein is the thinner of the two and varies from fourteen to sixteen inches in thickness. It has a hard roof of impure bituminous limestone about twelve inches in thickness

and is underlain by one and a half to two feet of fire clay. Twelve feet beneath is the second seam of coal about thirty inches in thickness. It is separated into an upper bench of twenty-four inches and a lower one of five inches by a thin seam of clay. The strata encountered in the workings at the old Smith mine were:

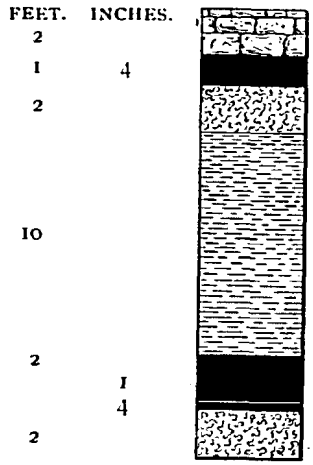


Figure 147. Section of Strata on Little Whitebreast Creek, at Smith Mine. Near Chariton.

In places the two seams come close enough together to be worked as one, but as a rule they are worked independently. The coal is rather soft and is often mined by the pick alone.

On the border of the creek directly east of Chariton, a distance of two and one-half miles, mines have been opened for more than thirty years. Many of the old diggings are now deserted. At the present time the Williamson mine (Tp. 72 N., R. XXI W., Sec. 15, SW. qr., SE. $\frac{1}{4}$) is one of the more important openings. It is a shaft and has worked an area of about 300 feet east and west and 400 feet north and south. The seam is quite undulatory but has a general dip to the southwest of four or five feet

in a hundred. In sinking the shaft at this point the following strata were passed through:

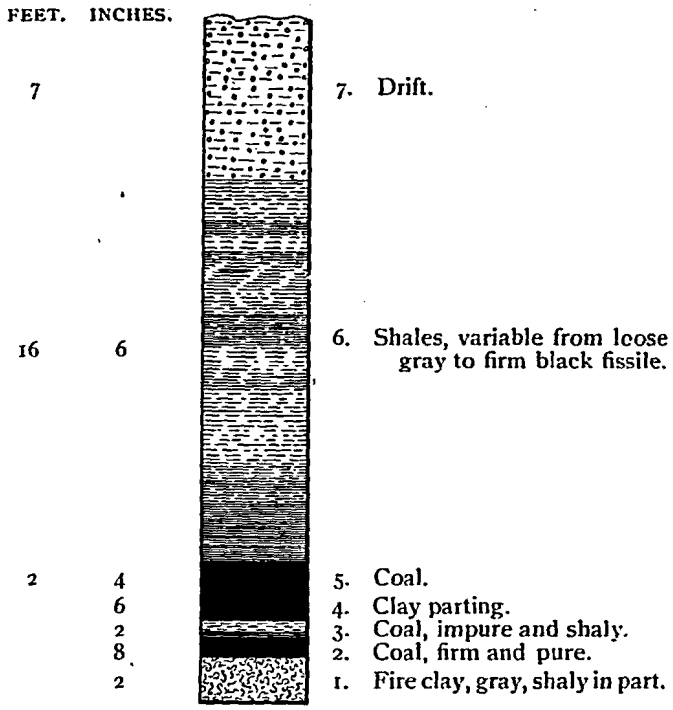


Figure 148. Strata Encountered in "Williamson Shaft." Near Chariton.

Half a mile to the southeast is the Wilson mine which has only recently been opened. About a half a mile north of the Williamson are two others, the Munson and the Perry mines.

Directly north of Chariton, a distance of three miles, a vein of coal one and a half feet in thickness crops out in the creek a short distance above its bed. In the various drifts which have from time to time been opened the coal varies from one and one-half to two and one-half feet in thickness. Several slopes have also been operated and considerable coal taken out to supply local demands. At the present time the principal mines working are six or

eight in number. The Smith and Maxwell opening is a new drift (Tp. 73 N., R. XXI W., Sec. 32, NW. qr., SW. $\frac{1}{4}$). Near it is the Smith mine which works two seams by separate drifts. Half a mile to the west are several small openings, among which are the Spear and Richmond mines. In the latter the following strata have been encountered:

FEET.	INCHES.		
6		6.	Shale, variable, calcareous.
2		5.	Coal.
	3	4	Clay parting.
	4	3.	Coal.
	3	2.	Fire clay, variable.
1		1.	Sandstone, shaly.

Figure 149. Coal Bed at Richmond Pit. Northeast of Chariton.

A quarter of a mile to the south is the old Maxwell drift; while a little farther on is the Porter mine. About a mile to the southwest is the Hall mine where coal is reached by a shaft twenty-five feet deep.

Minor Coal Localities.—In the northeastern corner of the county a few local mines have been opened in the same vein of coal which is mined to some extent in parts of Monroe and Marion county. This vein lies near the surface and is reached by means of drifts. It is from two and one-half to four feet in thickness, but has a rather poor roof in places. The mines are all on Cedar creek or its tributaries. The principal opening, the Stotts, is in the extreme northeastern corner of the county (Tp. 73 N., R. XX W., Sec. 1, NE. qr.). The Buchanan mine is

a half a mile southwestward, and the Van Loon a mile directly west.

At Zero, in the extreme eastern portion of the county, on the main line of the C., B. & Q. railroad, a mine was formerly operated by the Creston Mining Company. The shaft is 260 feet deep, with coal five feet in thickness. At the place opened the seam was quite irregular, on which account the mine was finally abandoned. Just beyond the boundary of Lucas, in Marion, coal has been mined at several places; also to the eastward in Monroe. In Appanoose, a couple of miles from the Lucas county line, mining has been carried on just above Milledgeville; and also a little to the west of that place, in Wayne county.

MONROE COUNTY.

This county is in one of the most productive portions of the Iowa coal field, and as a coal producer is becoming more important every year. The stratified rocks at the surface are almost entirely made up of coal bearing strata. Everywhere they are covered by drift deposits, in some localities to a very considerable depth. In the extreme northeastern corner of the county, along the Des Moines river and for a short distance up Miller creek, the Lower Carboniferous limestones are exposed. They rise in the banks of the streams to a height of from fifteen to twenty feet, presenting the usual character of the Saint Louis formation. Although these are the only outcrops of Lower Carboniferous limestone, borings along the south and west boundaries of the county show that it lies at no very great depth below the surface. The Coal Measures of this portion of the district are there, therefore, relatively thin. In this part of the county the Saint Louis limestone presents the same stratigraphical character as elsewhere

in the state; that is, the upper surface is very irregular, having been carved into hills and valleys previous to the deposition of the Coal Measures. In the center of the county and along the western and southern margins, the Coal Measures are very much thicker than elsewhere, probably more than 300 feet in many places. There are probably few localities of any great extent within the limits of Monroe where coal cannot be mined profitably, since the principal belt of the Coal Measures in the state passes through this region. The county contains some of the largest mines in the state.

Avery District.—In the northeastern part of the county including the areas comprising Pleasant Valley and Mantua townships coal has been mined extensively since the first settlement of the region. Early settlers knew of its occurrence in the Des Moines valley and it was mined at various points opposite Eddyville. Of late years coal has been worked but little in this vicinity, and at present the exposures are greatly obscured. The upper part of the bluff directly opposite Eddyville shows indications of a coal seam, probably the same found by Worthen in his trip up the Des Moines valley nearly forty years ago. This section is as follows:

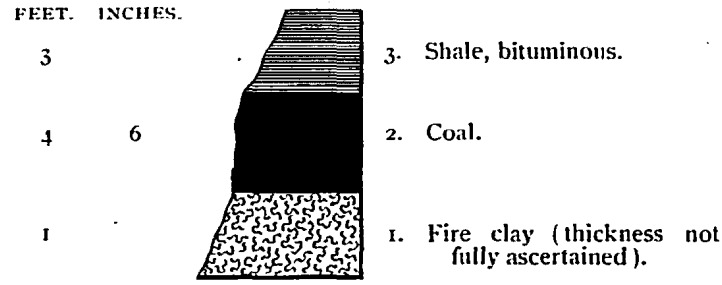


Figure 150. Bluff on Des Moines River, showing Coal Seam Opposite Eddyville.

The coal now worked in the northeastern part of the county lies at a somewhat greater depth than the seam

just referred to. It varies considerably in thickness, ranging from three and a half to six feet, with an average perhaps of about four feet.

Four miles southwest of Eddyville, at Coalfield, the Pleasant Valley mine is operated on a small branch of Miller creek (Tp. 73 N., R. XVI W., Sec. 16, SW. qr., SW. $\frac{1}{4}$). Different mines have been successively operated here at various times, but this is the only mine now taking out coal. It is a slope which has been driven back into the hill for a distance of 800 feet or more. The coal varies from three and a half to four and a half feet in thickness and is quite hard and clean. The vein dips slightly to the south and is covered with a heavy black shale which forms an excellent roof. The beds associated with the coal are:

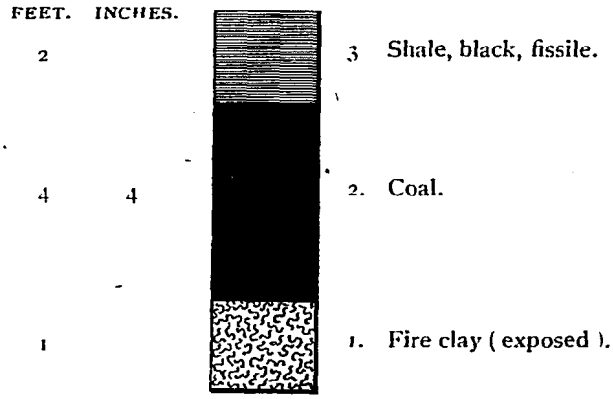


Figure 151. Bed in Pleasant Valley Mine. Coalfield.

Three miles southwest of Pleasant Valley is the Hickory mine apparently operating the same seam. The roof at this point is a sandstone instead of a shale. The dip is to the southwest and quite noticeable, being about ten feet in a hundred. Half a mile east of the Hickory is the Chisholm mine. It now belongs to the Whitebreast

Coal Company. It is a large mine, and is situated about half a mile from the C., B. & Q. railroad.

Near the station of Avery, coal is mined quite extensively. The Smoky Hollow mine, which is situated two miles east of the station (Tp. 72 N., R. XVI W., Sec. 10, NE. qr., SW. $\frac{1}{4}$), has connection with the C., B. & Q. by means of a private railroad. The coal is five feet in thickness and is reached by a slope, the main entry having been driven back nearly three-quarters of a mile. In the course of this work several channels filled with Carboniferous strata were encountered, showing that immediately after the deposition of the coal it was cut out and removed by strong currents. In places the coal is replaced for about one hundred feet by soft, buff sandstone. The same gray clay shale forming the roof has filled another cut out. In this mine five seams of coal are known to occur; there are two, varying in thickness from one to two feet, which are found twelve and twenty-five feet above the coal now mined. The section is:

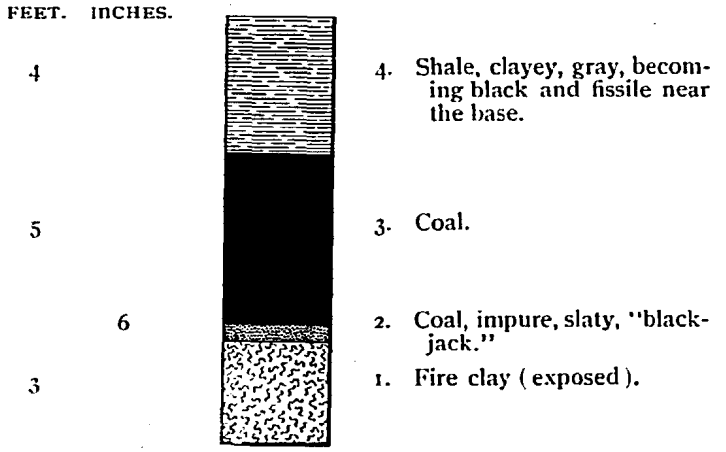


Figure 152. Coal in Smoky Hollow Mine, Avery

At several localities there were formerly small mines operating in this neighborhood, but as the territory

controlled was worked out, they were deserted. The Moyle mine, a quarter of a mile west of Smoky Hollow, is one which was only recently abandoned.

Two miles northeast of Avery station, at Fredric, is a small group of openings, only one of which is now in active operation. This one is worked by the Fredric Coal Company. It is a shaft about forty feet in depth, and works a seam three and one-half feet thick. A band of clay ironstone, thirty-two inches in thickness, runs through the middle of the seam and causes considerable trouble in mining. The difficulty is overcome to a certain extent by the adoption of the long wall plan. The arrangement of the details is:

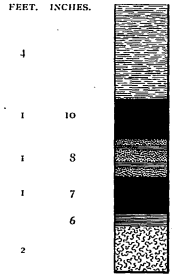


Figure 153. Part of Fredric Shaft. Fredric.

Immediately east of this mine is the Akers, and about half a mile to the northwest is the old Eureka shaft.

Albia District.—In Troy township, in which Albia and Gifford, lying immediately to the west, are located, quite a number of large mines have been operated for

some time. North of the town two thin seams of coal have been worked. They lie near the surface and are easily reached by slopes. The upper one is usually about twenty inches thick. The second lies eleven feet below and is slightly thicker, running as high as three feet. It is more extensively worked than the other. A hard black shale overlies the seam, forming a good roof wherever it is mined, while the comparatively soft under clay greatly facilitates the work of removing the coal. "Troubles" are few, but the vein is more or less undulatory. The coal is taken out at the King mine, about one and a half miles north of Albia (Tp. 72 N., R. XVII W., Sec. 10, SE. qr., SE. ¼) and at the Brewer shaft in the northwestern part of the same section. Three miles north of the town (Sec. 2, NW. qr.) is the Barnhill mine. Other openings have been made, reaching the coal at various points, but none are now in operation.

West of the city is an important group of large openings known, collectively, as the Cedar mines. The coal here varies from four to six feet in thickness and is from 120 to 150 feet below the surface, the difference of course being due mainly to the inequalities of the surface. The coal is somewhat undulatory, the variation of the different parts of the bed being eight to ten feet. The roof is a hard, black shale which is four feet or more in thickness. The Enterprise mine is located about one and a half miles west of Albia (Tp. 72 N., R. XVII W., Sec. 17 NW. qr., SE. ¼). Near it is the Iowa and Wisconsin mine, locally known as the Jack Oak, giving the following section:

		FEET.	INCHES.
3.	Shale, gray, becoming bituminous below....	2	
2.	Coal, normal thickness 4½ feet, here decreased by a "roll" to.....	1	7
1.	Fire clay (exposed).....	5	

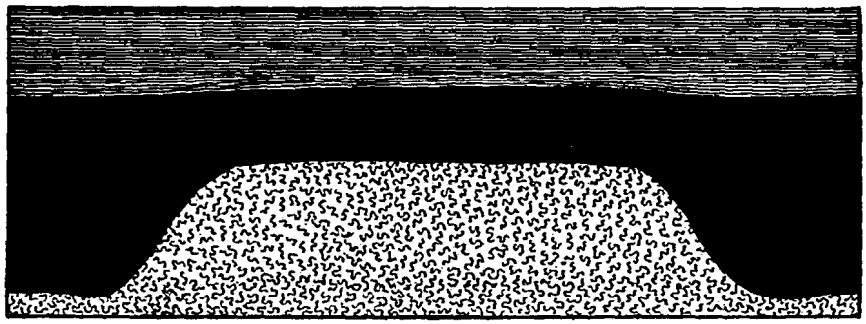


Figure 154. Coal Bed and "Horseback" in Iowa and Wisconsin Mine. Albia.

A short distance to the west is the Chicago and Iowa mine. These are all important mines with a large annual output.

About four miles northwest of these mines (Tp. 72 N., R. XVII W., Sec. 11, NE. qr., SW. $\frac{1}{4}$) is the Heitman, owned by the Wapello Coal Company. This is one of the largest mines in the state. It is connected with the main line of the C., B. & Q. railroad by a private track. The shaft is 142 feet deep and entries have been driven north 2,400 feet, south 800 feet, and west 2,500 feet. The coal runs from five to six feet in thickness, and is in good position for mining. A smaller eight-inch seam occurs about eighty feet above the one now worked, but is nowhere thick enough for profitable mining.

Soap Creek Valley.—In the southeastern part of the county at least three seams of coal have been at different times opened up. One of these now exposed, on a small ravine southeast of Foster, is eighteen inches thick. It is covered by a black shale which at the exposure is thin, but is said to thicken considerably, farther in the hill. This coal has been opened at several points but is almost too thin for profitable working, so that very little of it has been taken out.

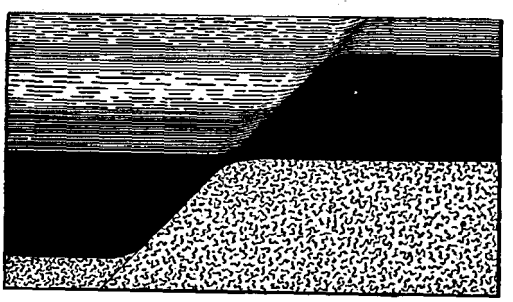
In the banks of the creek itself just north of Foster (Tp. 71 N., R. XVII W., Sec. 24, SE. qr., SW. ¼) are the old workings of the Soap Creek Coal Company. These consist of a couple of drifts which have been driven a considerable distance back into the hill. The coal is now only partly exposed, a section measured in an old slope showing:

		FEET.	INCHES.
4.	Shale, gray, clay	2	
2.	Coal	2	3
3.	Clay		7
1.	Coal		10

This property has passed into the hands of the Deep Vein Coal Company, which has abandoned the upper workings and has recently put down a shaft 200 feet deep about 300 yards to the south. Three veins of coal were encountered. The first, at a depth of fifty-four feet, is thirteen inches thick; the second, at ninety feet, is eight inches, and the third, the one worked, runs from four to seven feet. The seam is exceedingly undulatory. In one entry the coal rises twenty feet in 300 and thins out from five to two feet, while the fire clay beneath thickens correspondingly. At another place the coal goes down sixty feet in 400. In some places the slopes in the mine are so steep as to require gins for moving the loaded cars. Faults of greater or less extent are also frequently met with. The throw is usually small, though in places a displacement of six feet has been observed. One is shown in figure 155.

The slides frequently form step-faults with parallel trends. In one portion of the mine there is an area about one hundred yards wide and two hundred yards long in which the coal lies sixty feet below the general level. Entries have been driven along three sides of this sunken

area and its structure is now fairly well made out. The coal on all sides dips down toward the center, in places at an angle of 20°. Parallel to its edge slips, or true geological faults, are found. These have slickensides and all the phenomena usually accompanying them. The displacements have a down throw averaging about two feet. They are most frequent at the extreme edge of the basin and decrease towards the center. The coal along the lines of fault is badly seamed and cracked. The crevices are lined with calcite in broad sheets, the surface of which are



FEET.

3. Shale, bituminous.... 3

2. Coal, usually six feet in thickness, here only 2½

1. Fire clay (exposed).. 3

Figure 155. Fault in Deep Vein Mine. Foster.

thickly studded with beautiful crystals of dogtooth spar. Siderite is also very frequently found closely associated.

About a mile and a half west of the Deep Vein shaft is a smaller mine working in the same seam. It is owned by the Monroe Coal and Prospecting Company.

Minor Districts.— Outside of the large areas described coal has been found at numerous points and its presence at many other places may be readily inferred. In the northwestern part of the county and the adjoining portions of Marion, Lucas and Monroe, a coal field of considerable extent is known. It is probably more or less intimately connected with that of Marysville, in Marion county. The coal mined in this area varies from three to

four feet in thickness. It lies near the surface and is reached by drifts.

Two mines have been opened in this portion of Monroe county. One is the May drift, a rather important local opening in the extreme northwest corner of the district (Tp. 73 N., R. XIX W., Sec. 6, NW. qr., SE. ¼). About one mile south is a smaller mine known as the Bingham drift.

In the northern part of Appanoose county, which adjoins Monroe on the south, a seam of coal which has been mined extensively is known to closely approach the county line at several places. It has been mined at Milledgeville, about two miles south of the boundary line. Another coal vein has been mined at Zero, in Lucas county, two miles west of the county limits. In Wapello county coal has been opened at Blakesburg, within a half a mile of the Monroe line; while in Marion county, on the north, the extensive Marysville coal field has been opened up within a couple of miles of the divisional line.

WAPELLO COUNTY.

The surface of Wapello county is considerably broken. The valley of the Des Moines river, which runs through the county from northwest to southeast, is bordered by steepsided ravines which branch out in all directions toward the more level upland. The drift is comparatively thin as a rule, though in places sufficiently thick to prevent the indurated rocks below from cropping out. Lower Carboniferous limestones are exposed in the bed of the Des Moines river and often rise from thirty to forty feet above low water level. These rocks, which are chiefly the Saint Louis limestones, are also found in the beds of many

of the smaller water courses. The Coal Measures, however, may be regarded as occupying by far the greater part of the county immediately beneath the drift. There are exposures on all the leading streams, at many of which good coal seams have been opened by drifting. At several points veins of coal are exposed in the bed of the Des Moines river and have been quarried quite extensively. Along the river and steep bluffs, which often form high mural escarpments, these also border many of the smaller streams of the county. The principal coal mines have been opened in the bluffs on either side of the Des Moines river, the leading mining center of the county being Ottumwa.

Cedar Valley.— Although no mines of any great extent have been opened in the northeastern part of the county there are numerous indications that good deposits of coal exist in this part of the district. In the near future they will probably assume commercial importance.

Des Moines Valley.— As already stated the principal mines of the county are confined to the immediate neighborhood of the river. In the extreme northwestern corner of the county, in the vicinity of Eddyville, coal has been mined from the earliest settlement of the region. Several mines have been opened, not only in Wapello, but in the adjoining portions of Mahaska and Monroe counties. A mile below Eddyville, on the west side of the river, a vein three and one-half feet thick was mined for a number of years near the top of the bluff. The principal mines now working in the vicinity of Eddyville are about two and one-half miles east of the railroad station. The most important of these is the Dotts (Tp. 73 N., R. XV W., Sec. 3, SW. qr., SE. $\frac{1}{4}$). The average thickness of the coal seam is about four feet, but it sometimes runs as high

as five feet. The vein is somewhat undulatory, but has a slight general dip northward. A mile north of the Dotts is the Clarke mine, and a mile and a half southeastward is the McGlothlin, neither of which is working at the present time. In the same neighborhood ten or a dozen or more country banks have been in operation from time to time during the last twenty years. Four miles below Eddyville coal is exposed in the bed of the Des Moines river and is sometimes quarried for local use.

Near Kirkville mining has been carried on along a small creek. The mines are located chiefly south of the town, between the village and Kirkville station. The most easterly is the Wadell. A mile directly south of the town is the Davis mine (Tp. 73 N., R. XIV W., Sec. 18, NE. qr., SE. $\frac{1}{4}$). The section in connection with the coal is as follows:

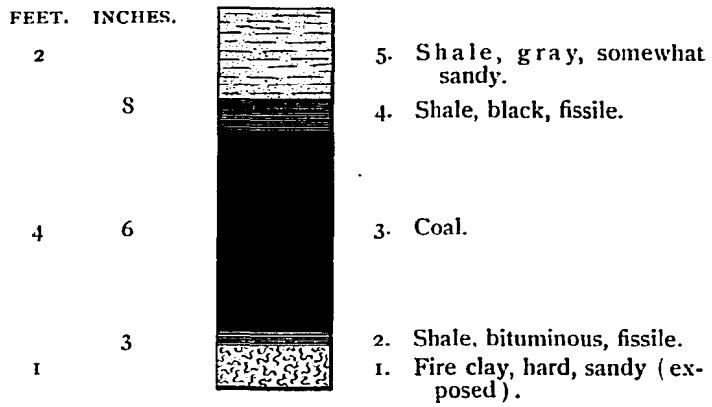


Figure 156. Bed in Davis Mine, Kirkville.

In the same vicinity were located the extensive mines of the Wapello Coal Company which are now abandoned. Coal is exposed and is mined at short intervals along the creek for a distance of several miles. Among the mines now opened here are the Bennett, which is three-fourths of a mile southeast of the Davis; the Lancey, a mile and

a half southward of the same place, and the Vanderpool, which is a short distance east of the Lancey.

The most extensive mining in the county is northwest of Ottumwa. Near the old Union mine now deserted (Tp. 73 N., R. XIV W., Sec. 33, SE. qr., SW. ¼) coal crops out at many points.

A mile directly east of the Union working is the Daniel mine, and a few hundred yards to the south of the latter is the Keb slope or Whitebreast No. 22. It works in a vein four to four and one-half feet in thickness, probably the same which crops out for a considerable distance along a ravine opening to the south. The section shown in connection with the coal is:

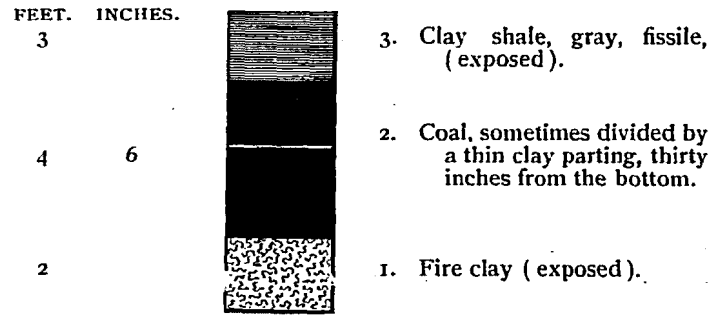
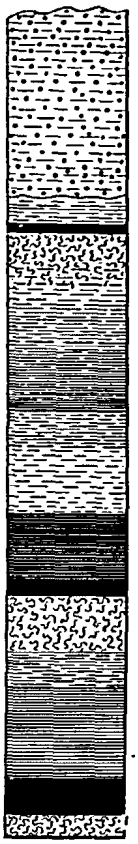


Figure 157. Coal Seam with Clay Parting, Keb Mine. Keb.

The workings of this mine and the one just north of it come within a few hundred yards of one another, but the seam of the one is about thirty feet higher than that of the other mine, and a fault is thought to exist between the two. Directly south of Keb, a short distance, are several mines, the nearest of which is about a quarter of a mile away and is known as the Baker mine. The others are the Metzgar and Tailor, both of which are situated on Crockett run. A mile and a half southeast of Keb are several larger mines (Tp. 72 N., R. XIV W., Sec. 12, NW. qr., NW. ¼). These are the Phillips Nos. 2

and 4. The latter is the most northerly and is a new mine. The section of the prospect shaft is as follows:



FEET.	INCHES.		
20		11.	Drift, soil and clay.
3	6	10.	Clay shale, white.
		9.	Coal.
31		8.	Fire clay and clay shale.
7		7.	Shale, dark, bituminous.
1	6	6.	Coal.
6		5.	Fire clay.
4		4.	Shale, light colored.
10		3.	Shale, dark, somewhat fissile.
4		2.	Coal.
2		1.	Fire clay (exposed).

Figure 158. Section of Shaft of Phillips No. 4. Ottumwa.

The coal seam, which is four feet in thickness, is quite even and has an excellent roof. Shaft No. 2 is a short distance southward and works in the same vein of coal. It has opened out for a distance of more than a mile to southeast from the bottom of the shaft. The Ream mine is a short distance towards the north. It is ninety feet in depth and works coal from two to three and one-half feet in thickness. Half a mile south of the Phillips No. 4 is No. 3 of the same company, and in the same vicinity

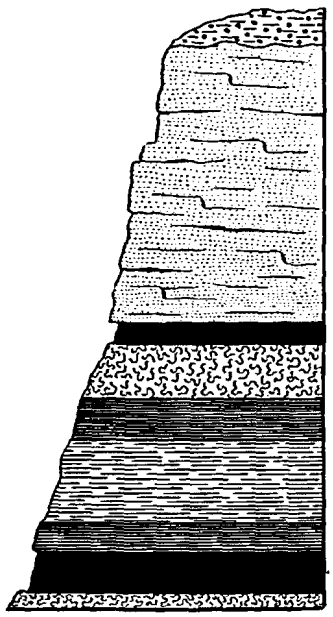
are the Hawkeye, now abandoned, and the Black Diamond mines, the latter being a shaft sixty feet in depth.

In the brick yard in the western part of Ottumwa (Tp. 72 N., R. XIV W., Sec. 14, NE. qr., NW. ¼) the following section is seen:

		FEET.
10.	Shale, light colored	5
9.	Shale, dark, bituminous	3
8.	Coal	2
7.	Fire clay, and light colored shale	7
6.	Shale, bituminous, fissile below	5
5.	Coal	⅓
4.	Shale, gray and often sandy	3
3.	Shale, black	6
2.	Coal	4
1.	Fire clay (exposed)	2

The strata at this point have a slight dip eastward. A mile and half to the southeast is the Spring Hill mine, which is a shaft located within the corporate limits of Ottumwa. There are two seams of coal, one three and one-half, and the other four feet in thickness. In the middle of the upper seam, which is the vein principally worked at the present time, is a thin band of slaty coal. In Ottumwa, on the Fourth street hill, two thin seams of coal are exposed, and it seems quite probable that thicker veins exist below the visible outcrop.

Farther eastward, in the vicinity of Dahlonega, the presence of workable coal is known along the valley of Sugar creek, and country banks have been opened at intervals. Directly east of the city on the same creek several small mines are also open. Near the mouth of the creek (Tp. 72 N., R. XIII W., Sec. 31, SW. qr., SE. ¼) the following section is shown in connection with the coal worked:



		FEET.
9.	Soil	2
8.	Sandstone, coarse grained, massive, yellow and brown	20
7.	Coal, rather slaty	1½
6.	Fire clay	4
5.	Shale, very dark, bituminous, somewhat fissile and dark below	3
4.	Shale, gray, argillaceous	6
3.	Shale, black, bituminous	2
2.	Coal	3
1.	Fire clay (exposed)	1

Figure 159. Bluff in Sugar Creek. East of Ottumwa.

About one hundred yards farther down the creek from the section given, near the wagon bridge, a thick limestone is exposed in the bed of the stream. On the south branch of Sugar creek are several exposures of coal and coaly shale with the associated fire clays and shales, the whole overlain by a massive sandstone of considerable thickness. Two seams of coal have been opened. The higher vein lies immediately beneath the sandstone and has a thickness of eighteen inches. The lower vein is thirty to forty inches in thickness and lies below the bed of the creek, about twenty-five feet below the upper seam. Considerable coal has been mined along the bluffs by stripping or quarrying. Near the mouth of Sugar creek, in the bed of the Des Moines river (Tp. 72 N., R. XIII W., Secs. 32 and 33) a seam of coal two and one-half to four feet in thickness is exposed at low water level.

Recently it has been extensively quarried by three different companies, the water being kept out by means of cribs. The coal is separated into two benches, the upper of which is more friable than the lower and contains small concretionary masses of impure limerock. A mile farther down the stream is the Vangant and Dixon mine, which at the present time is not in operation. Coal has also been taken out a short distance below this point, in the bluffs along the Des Moines river and in the sides of a small creek coming in from the north. Three miles below Cliffland station, at a place formerly known as Alpine dam, considerable mining has been carried on, especially in the early days of the settlement of the region. Between the last two points perpendicular cliffs of brown and yellow sandstone rise to a height of from twenty-five to fifty feet above the railroad track at the base.

At Eldon, above the wagon bridge, a coal seam is exposed in the river bank just above the Saint Louis limestone. Two miles directly south of Eldon, on the southwestern line of the C., R. I. & P. railroad, is the Eldon mine (Tp. 71 N., R. XII W., Sec. 32, SE. qr., SE. $\frac{1}{4}$). The section is shown in figure 160.

On the south side of the Des Moines considerable coal has been mined in Wapello, but not to the extent that it has on the opposite side of the river. In the extreme northwestern corner, near Eddyville, several mines were formerly operated but at the present time they supply only small local demands. A mile south of Dudley, on a branch of North Avery creek (Tp. 72 N., R. XV W., Sec. 4, NW. qr., NE. $\frac{1}{4}$), is the old Arnold mine which at the present time is not in operation.

Five miles west of Ottumwa and about a mile directly west of the C., B. & Q. railroad bridge across the Des

Moines river the old Union mine is located, besides several other drifts and slopes. Seven feet of coal are reported in places. Most of these openings are now aban-

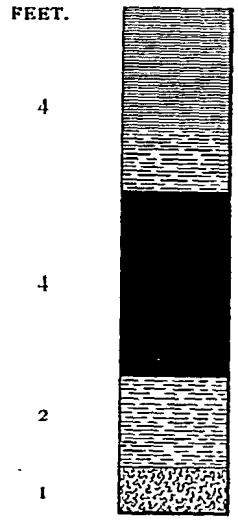


Figure 160. Coal Bed at Eldon Mine. Laddsdale.

doned, but the industry has recently been revived in this vicinity by the sinking of a shallow shaft a short distance west of the others.

Two miles directly south of Ottumwa several openings have been made, the principal one of which is the Pickwick mine (Tp. 71 N., R. XIV W., Sec. 1, SW. qr., NW. $\frac{1}{4}$). The section shown in connection with the coal is given in figure 161.

The seam is very slightly undulating and has a general dip northward. Several slips have been observed but none of the faults are very extensive. In several instances drops having a throw of five or six inches have been observed in the top of the vein, the line of dislocation dying out before reaching the bottom of the stratum. A quarter of a mile westward is the Lewis and Jones mine, a shaft ninety feet in depth and operating in coal three

and a half to five feet in thickness. Several other shafts are located in this vicinity, among which is the Styre mine. The seam of coal worked here is probably the

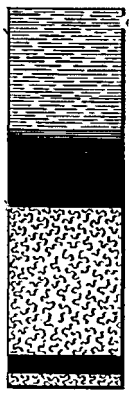


Figure 161. Bottom of Shaft in Pickwick Mine Ottumwa.

same as that found in the bed of the Des Moines river three miles to the east.

Bear Creek.—This stream rises near the western county line, near Blakesburg, and runs directly eastward, emptying into the Des Moines at Ottumwa. Mines have been opened at various points along the creek, especially since the C., M. & St. P. railroad has built its southwestern line in the valley of this stream. Three miles northeast of Blakesburg is the Appanoose mine (Tp. 72 N., R. XV W., Sec. 33, NW. qr., NE. $\frac{1}{4}$). The main entry has been driven nearly half a mile from the bottom of the shaft, the coal thickening towards the northeast. The section is as follows:

		FEET.
4.	Clay shale, black, somewhat fissile	10
3.	Coal	4
2.	Fire clay	2
1.	Shale, carbonaceous, fissile (exposed)	1

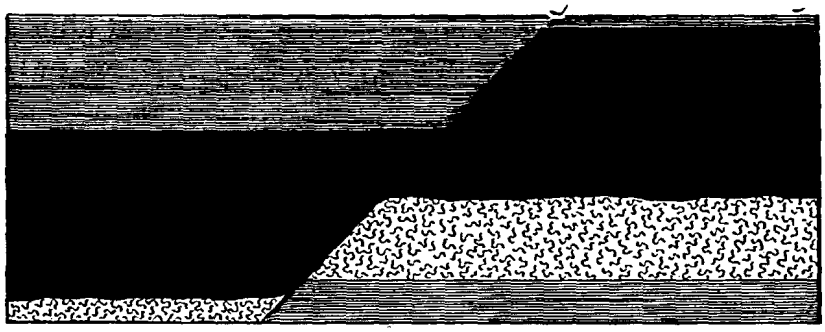


Figure 162. Coal Bed, with Fault, in Appanoose Mine. East of Blakesburg.

A mile and a half northwest of the Appanoose are several openings, among which is the Major mine. East of the Appanoose are also mines, the Willard being the most important A few miles below, the coal crops out in the bed of the stream. Farther down it is overlain by massive sandstone. Between this point and Ottumwa coal appears at many places and country banks have been opened.

JEFFERSON COUNTY.

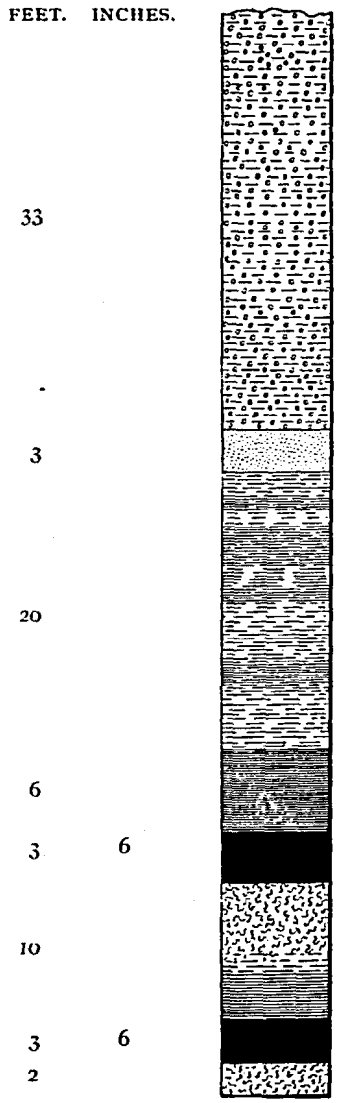
Coal has been mined in commercial quantities in Jefferson county for a greater period probably than in any other similar district in the state. This is probably due partly to the early settlement of the region and partly to the fact that the veins worked are confined chiefly to the hills, where many natural exposures occur and where the coal may be readily reached by drifts, slopes and shallow shafts. Consequently for many years this county has ranked among the more important coal districts of the state and the production at one time was upwards of 50,000 tons per annum.

Although the county is underlain everywhere, at no great distance below the surface, by the great limestone series of the Lower Carboniferous age, this formation has

a comparatively limited surface distribution. It appears only in the immediate vicinity of the larger streams in the eastern part of the county; along the Skunk river, where it extends in places well up into the bluffs, and in the beds of some of the smaller tributaries of this stream, where it is exposed for a distance in some cases of several miles above their mouths. On Cedar creek the Lower Carboniferous limestones extend more than half way across the county to a point three miles directly southwest of Fairfield. The rocks of the same age probably occur in very limited areas in the southwestern corner of the county where it nearly reaches the Des Moines river. The basal limestone which is exposed in Jefferson belongs to the Saint Louis formation—the only member of the Lower Carboniferous series known to occur in the district. Like in all of the neighboring counties, the Saint Louis rocks present an upper surface which is very uneven, showing evidence of profound erosion previous to the laying down of the Coal Measure strata. In this county the thickness of the Coal Measures varies greatly, even if measured from a perfectly level horizon above.

With the exception of the smaller areas of the Saint Louis limestone just mentioned, Jefferson is entirely underlain, immediately beneath the drift, by Coal Measure strata. The thickness varies greatly in different places from a few feet to a maximum of possibly 200 feet, the average vertical measurement being probably in the neighborhood of seventy-five feet. Although the coal has been mined at numerous localities throughout the county, its disposition is not in a single layer or in two layers extending entirely over the region, as was formerly supposed, but is formed into innumerable pockets of quite limited extent. These small basins are situated at many

different horizons and overlap and interlock one another on all sides. In most cases the coal lies but a short distance above the limestone basement and, towards the eastern margin especially, even comes in contact with the underlying calcareous rocks. The occurrence of the



FEET.	INCHES.		
33		28.	Drift.
3		27.	Sand.
20		26.	Clay, dark. shaly.
6		25.	Shale, black.
3	6	24.	Coal.
10		23.	Fire clay and shale.
3	6	22.	Coal, shaly.
2		21.	Fire clay (exposed).

Figure 163. Section of Shaft of Washington Mine Perlee.

coal deposits in many small basins is, perhaps, more apparent in Jefferson county than in any other district in the state.

Near Perlee, seven miles northeast of Fairfield, the preceding section (figure 163) was passed through in sinking a shaft of the Washington Coal Company about a mile east of the station.

A prospecting hole, put down by I. P. McElhaney, beginning just below the coal vein worked, gave the following section:

		FEET.	INCHES.
21.	Mixed clays	18	
20.	Gray shale	10	
19.	Sandstone	12	
18.	Limestone, gray, impure	8	
17.	Sandstone, fine grained, with brown flinty partings, laminated, yellowish color	22	
16.	Sandstone, bluish, fine grained, heavily bedded	20	
15.	Sand shale	10	
14.	Limerock, impure	2	4
13.	Sand shale, gray, fine grained	8	
12.	Clay shale, blue	3	
11.	Sand shale, blue, with thin, irregularly bedded, impure sandrock	37	
10.	Limestone, impure, buff colored, fragmentary	2	
9.	Clays, marly, blue, with small fossils	1	
8.	Limestone, impure, bluish	3	
7.	Sand shale, light blue, with sandstone partings	7	
6.	Limestone, compact, gray, fragmentary and concretionary	2	
5.	Shale, argillaceous, blue, and limestone	2	6
4.	Shale, argillaceous, gray	3	6
3.	Limestone, concretionary, compact, light gray	4	
2.	Marl, gray	2	6
1.	Limestone, concretionary, light, with gray clay partings	22	6

Below No. 10 the strata belonged to the Lower Carboniferous. The entire thickness of the Coal Measures at this point is, therefore, about 175 feet.

The most extensive mining operations ever carried on in the county were at Perlee, the chief mines belonging to Washington County and to the Jefferson County Coal Companies. The Washington shaft which has just been mentioned and a section of which has already been given, was located some distance from the railroad (Tp. 73 N., R. IX W., Sec. 32, NE. qr., SE. $\frac{1}{4}$) and the company was obliged to haul the output over a tramway in order to load the coal directly on the cars. The coal vein formed a rather extensive pocket with a solid seam from three and a half to four feet in thickness. The middle eighteen inches was considered to be a very good quality of coal for the manufacture of gas and was used for this purpose. According to the best information obtainable the coal was deposited in a rather narrow trough, probably not over one-fourth or one-third of a mile in width and trending northeast and southwest.

The Jefferson mine was a shallow shaft near the railroad (Tp. 73 N., R. IX W., Sec. 23, NE. qr., SW. $\frac{1}{4}$).

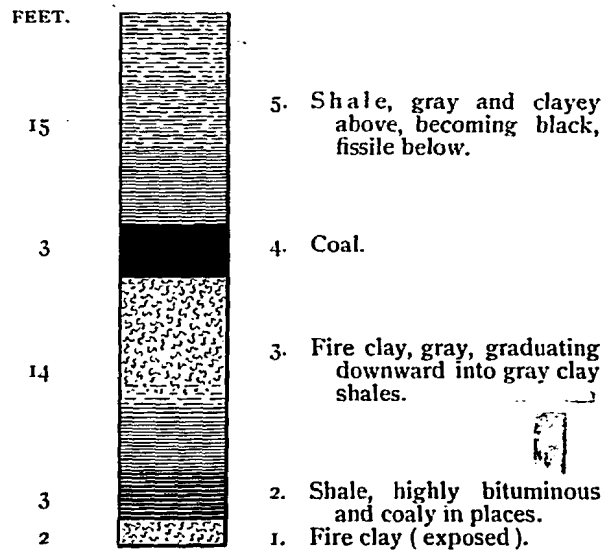


Figure 164. Part of Jefferson Shaft. Perlee.

The coal mined was practically the same as that worked at the Washington mine. The roof was a dark shale, four to eight feet in thickness, while the floor was fire clay and light colored shales, having a thickness of ten to fourteen feet. Immediately beneath is a vein three and a half feet thick, of rather shaly coal. This arrangement is shown in figure 164.

Almost the entire output of this mine was taken by the railroad company for use in the locomotives. Both the Jefferson County and Washington County mines have been abandoned for several years. During the latter years of their existence they furnished considerable more than one-half of the entire output of the county.

Recently the Sheckelton mine, a country bank, has been operated and some coal taken out. This and several other small banks are the only ones now in operation in the vicinity of Perlee.

Figure 163. Section of Coal Seam. Coalport.

At Coalport, near the east edge of the county, coal has been mined for more than thirty-five years. During most

of this time the Brown mines have been actively operating. The present shaft is about seventy-five feet in depth and is situated about a mile from the C., B. & Q. railroad, to which the coal is hauled over a tramway. The coal worked is from four to five feet in thickness and lies only a few feet beneath the bed of the neighboring creek. The seam appears somewhat uneven and in places the coal has been washed out by preglacial streams the old channels being occupied by sandstone. A section at this mine is indicated in figure 165.

Most of the coal is sent to Mount Pleasant and the neighboring towns.

Ten or a dozen shafts have been worked at various times in the immediate vicinity of the present Brown mine, but at this time none of them are being operated, except during the winter season. Across the creek a number of small country banks have been opened in the hillside, but at present they do not take out much coal.

Along Cedar creek south and west of Fairfield coal has been worked for many years. Directly south of town and just west of where the Birmingham road crosses the creek the Bates mine is located. It is a shaft sixty feet deep with coal four feet in thickness. The base of the shaft shows:

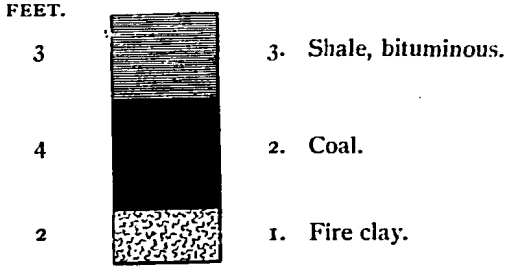


Figure 166. Coal Bed at Bates Mine. Fairfield.

Most of the production from this mine is taken to Fairfield. An exposure on Cedar creek, about half a mile to the northwest, gives the following section:

		FEET.	INCHES.
7.	Drift	4	
6.	Sandstone, buff, rather soft and somewhat shaly	4	
5.	Shale, argillaceous, dark blue	10	
4.	Coal		10
3.	Fire clay	4	
2.	Shale, dark color	8	
1.	Sandstone (exposed)	1	

Along both sides of the stream, between the point mentioned and the Reed mill, four miles above where the C., R. I. & P. railroad crosses the stream, numerous country banks have been opened from time to time, several being now worked during the winter season. At Reed mill the section is as follows:

		FEET.	INCHES.
10.	Drift	6	
9.	Shale, dark colored, with thin coaly seams	2	
8.	Shale, light colored	3	
7.	Shale, somewhat sandy in places, graduating below into No. 6	2	6
6.	Sandstone, fine grained, buff, containing plant remains	6	
5.	Shale, bituminous, with seams of coal three to six inches in thickness	4	
4.	Shale, light colored	8	
3.	Shale, dark colored, bituminous	2	
2.	Coal	3	6
1.	Fire clay (exposed)	1	

The coal is sometimes exposed in the beds of the streams. A mine was operated here by Mr. Reed for a number of years, the machinery being worked by power from the mill. Half a mile northeast of this point, where the Libertyville road crosses the railroad track (Tp. 71 N., R. X W., Sec. 3, NE. qr., NW. $\frac{1}{4}$), a mine has been

operated by Mr. Radcliff in a vein which is supposed to be the same as the thin seam near the top of the Reed mill section. At this place it is three feet in thickness. Immediately west of Fairfield, in the valley of a small creek running eastward into the Cedar, and along the line of the railroad, numerous openings have been made from which considerable coal has been taken. Many of these are now abandoned. At the West mine, about two miles and a half from Fairfield, the coal is three feet thick and is only thirty feet below the surface. Between Fairfield and the western county line a number of country banks have been operated from time to time. At and in the vicinity of Batavia prospecting holes put down recently show a vein of coal to be well developed, and mining will be commenced on a rather extensive scale at this place in the near future.

South of Libertyville about three miles, on Lick creek, near the county line, considerable coal has been mined.

The Zimmerman shaft (Tp. 71 N., R. X W., Sec. 29, SW. qr., NW. $\frac{1}{4}$) operates in a three-foot vein of good coal, the roof of which is an impure limestone. A quarter of a mile to the west is the Beyer bank, the coal of which is thought to belong to a higher horizon than that worked at the Zimmerman mine. Other country banks are also in operation in the neighborhood. A half a mile southward is the Laughlin bank, operating in a vein three and a half feet in thickness.

Another point where coal has been mined to a considerable extent is two miles south of County Line, where it crops out along the small stream known as Black creek. The Snooks bank is the chief mine operated, but is worked only in the winter. The coal is reached by a shaft twenty-four feet in depth, and varies from three and

a half to five feet in thickness. In a few places the coal is cut out completely by channels, but these obstructions are not very extensive.

WAYNE COUNTY.

For the most part Wayne county lies on the western limits of the Lower Coal Measure zone of Iowa. The greater part of the district is thickly covered by drift, often to a depth of 200 feet or more. Up to the present time mining has been confined almost entirely to the extreme eastern part of the county. The coal worked is the Mystic seam and is a continuation of the principal layer which is worked so extensively in Appanoose county. In the northeastern corner the coal crops out in the valley of the Chariton river, also along the South Chariton and some of its tributaries five or six miles southward. On Little Walker creek the following strata are exposed:

FEET.	INCHES.		
4		7.	Drift.
1	8	6.	Limestone, blue, fossiliferous, thick bedded.
1	4	5.	Shale, bituminous, fissile.
1	5	4.	Coal.
	2	3.	Clay parting.
	9	2.	Coal.
2		1.	Fire clay, gray, impure.

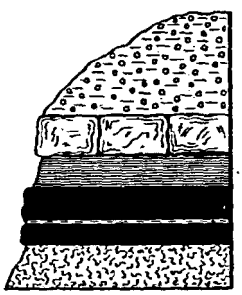
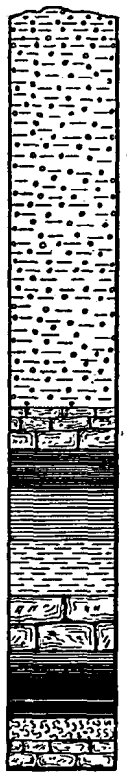


Figure 167. Bluff on Little Walker Creek. North of Confidence.

In the southeastern part of the county, at Seymour, this coal is found 250 feet from the surface. The strata containing the coal have a dip to the southwest of approximately five feet to the mile, which corresponds essentially with the observations made along the same line in Appanoose. It is quite probable that at least the eastern third

of Wayne is underlain by the Mystic coal in sufficient thickness for profitable working.

Along the Chariton river small drifts have been made in a number of places, while just east of the county line, a mile or two, in Appanoose county, important mines have been opened. The principal local development of the coal industry of Wayne is in the vicinity of Confidence, three or four miles from the Chariton river. The coal here crops out in a number of places and is reached by slopes and shallow shafts. In this vicinity the coal has been mined for local use for the past twenty-five or thirty years. The largest of these mines now in operation is the Frey shaft (Tp. 70 N., R. XXI W., Sec. 26, NW. qr., NE. $\frac{1}{4}$). The section in the shaft is:



FEET.	INCHES.	
28		11. Drift.
3		10. Limestone, gray, thinly bedded.
3		9. Shale, firm, bituminous.
3	5	8. Shale, clayey, dark drab.
4		7. Shale, light gray to blue.
4		6. Limestone ("cap rock").
1		5. Shale, drab, clayey ("clod").
	10	4. Shale, black, fissile.
2	6	3. Coal.
1	6	2. Fire clay, impure, gray.
2		1. Limestone, gray, fossiliferous.

Figure 168. Section of Frey Shaft. Confidence.

This mine has been operated a dozen years or more. The coal is reached by a shaft fifty feet deep. The seam has a good roof and the coal is taken out by the long wall method. The details of the coal bed are:

FEET.	INCHES.		
1		7.	Shale, bituminous, fissile.
1	8	6.	Coal.
	2	5.	Clay parting.
	7	4.	Coal.
	½	3.	Clayey parting, containing much pyrite.
	1	2.	Coal.
1		1.	Fire clay, impure.

Figure 169. Coal Seam in Frey Mine. Confidence.

A short distance northeast of the Frey mine is the Matley shaft, while immediately to the northwest of it is the Burns mine, where the section gives:

FEET.	INCHES.		
2		6.	Shale, bituminous, fissile.
1	6	5.	Coal.
	2	4.	Clay parting.
	9	3.	Coal.
1	8	2.	Fire clay, gray, shaly in part.
1		1.	Limestone (exposed).

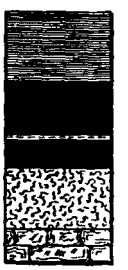


Figure 170. Coal Bed in Burns Mine. Confidence.

In the southwestern part of the same section is the Jared mine, and in the same vein is the Davis and Radcliff. All of these mines are operated for local trade only. They are located along Little Walnut creek and reach the coal at various depths.

At Seymour, fifteen miles south of Confidence, on the C., B. & Q. railroad, coal is mined at a depth of 240 feet.

There are two companies now operating. The Seymour mine is on the east edge of town, while the Chicago mine is farther west. Both companies have well arranged plants and handle considerable coal. At the former the base of the shaft shows:

FEET.	INCHES.		
1	10		8. Limestone, gray, fossiliferous (exposed).
	6		7. Clay, drab, shaly ("clod").
	10		6. Shale, bituminous, fissile.
1	4		5. Coal.
	2		4. Clay parting.
	9		3. Coal, with an occasional thin clay parting.
1	3		2. Fire clay.
1	10		1. Limestone, thick bedded, gray.

Figure 171. Part of Seymour Shaft. Seymour.

Seven miles west of Seymour, a short distance southeast of Harvard station, is located the Winger mine (Tp. 68 N., R. XXI W., Sec. 14, SE. qr., SE. $\frac{1}{4}$). The shaft is 165 feet deep with the following section at the bottom:

FEET.	INCHES.		
3			6. Shale, black, fissile.
1	2		5. Coal.
	2		4. Clay parting.
	8		3. Coal.
2	6		2. Fire clay.
3			1. Limestone, gray.

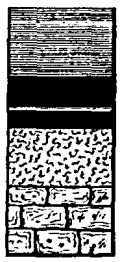


Figure 172. Bed of Winger Mine. Howard.

Coal is mined in several places a mile or two to the east of the county, at Milledgeville, in the northern part of the adjoining county, at Plano in the central, and Livingston in the southern. Coal seams also appear a few miles south

of the western part of Wayne county, in Mercer county, Missouri.

APPANOOSE COUNTY.

Appanoose county is located in the midst of one of the most extensive coal fields of the Iowa-Missouri area. The vein of coal which is principally worked is believed to have the greatest geographical extent of any of the seams of the region. For this reason and on account of the exceptionally regular character of the beds of the county, it ranks among the foremost of the coal producing districts of the state. The first reliable statistics in regard to the output of the Iowa coal fields were made in 1860. At that time Appanoose ranked eleventh among the counties of Iowa. The total production was less than 1,500 tons and had a market value of about $2,700. Since that time the production of coal has steadily increased until in 1891 the county was credited with a grand total of nearly 400,000 tons, with a valuation of more than half a million of dollars, thus raising the rank of Appanoose to third among the coal counties of the state. More than fifty mines are now in operation within the limits of the county besides the country banks, which get out a very considerable amount for local use.

The geological features of Appanoose county and the region adjacent to it in the west and south differ from those of the other coal counties in the Lower Coal Measure belt in presenting great regularity in the arrangement of the coal bearing strata. No Lower Carboniferous limestone is known to have a surface exposure within the limits of the county, though no doubt it occurs at no very great distance beneath the surface, especially in the eastern part of the district. The Lower Carboniferous layers

present gentle folds which, taken into consideration with the very uneven eroded surface of elevations and depressions, greatly affect the thickness of the coal bearing rocks in different places.

Another element giving a variable thickness to the Coal Measures of the county is preglacial erosion which has grooved and channeled the upper surface of the coal beds; these effects now being hidden by the thick deposit of glacial material.

The Lower Coal Measures underlie the entire county. The lithological characters of the beds differ very materially from those in other portions of the Lower Coal area of the state. The argillaceous shales make up the greater part of the formation. The sandstones are rather unimportant; while on the other hand there are a couple of rather thick limestone bands which occur in nearly all portions of the county.

A general section of the strata at Centerville shows:

		FEET.	INCHES.
16.	Soil, fine black	2	
15.	Clay, yellow	33	
14.	Boulder clay, blue, containing fragments of wood, coal, limerock and boulders	30	
13.	Limestone	6	
12.	Clay shale, blue ("soapstone")	3	
11.	Clay shale, red ("soapstone")	11	
10.	Sandstone, soft, containing thin, harder layers	8	
9.	Clay shale	10	
8.	Limestone, compact, gray	3	
7.	Shale, bituminous, frequently containing nodules and pyrite	7	
6.	Limestone ("cap rock")	3	6
5.	Shale, hard, black ("slate")	1	2
4.	Coal	1	8
3.	Clay partings		2
2.	Coal	1	2
1.	Fire clay	3	

It is fairly representative of the character of the rocks over most of the county, as far down as the coal vein worked so extensively at present. The thickness and the character of these different layers vary within certain limits, but the general features of the section may be considered as fairly constant. Other bands of limestone make their appearance occasionally and the character of the shale is of course inconstant. The presence of Nos. 8 and 13 is tolerably constant throughout the field. They are known respectively as the "seventeen" and "fifty-foot" limestones, from their general occurrence at about those heights above the coal. They may be relied upon as being fairly accurate guiding marks, though they have in certain places been removed by later erosion. As compared with the other coal seams in the state the extent of the vein in question is, as has been said, somewhat exceptional. An examination of the exposures on Little Walnut creek, at Mystic, will well show several features of the vein which are particularly characteristic and which make its recognition easy and certain. The association of strata found here is perhaps one of the best examples in the state showing the value of certain layers as guides to coal seams.

The principal coal vein worked has been called the Mystic coal, and is one of the few veins in the state which has a considerable geographical extension. It is named from the town where it has been mined so extensively. The quality of the coal is excellent. It is a clean lustrous variety having, in small pieces, the appearance of anthracite, though softer and more brittle. In mining, no powder is used, as the coal is readily broken by the pick in suitable sizes along the lines of natural cleavage. Analyses show that much of it would make an excellent

coal for the manufacture of illuminating gas. Already it has been used largely as a steam coal. It is especially well adapted for domestic use on account of its cleanliness and good heating qualities. Although small quantities of "sulphur" (iron pyrite) is present, the quantity is not sufficient to depreciate the value of the coal.

In the Appanoose coal district the arrangement of the various beds enclosing the coal is very much more simple than in most other parts of Iowa. Almost everywhere the developed coal beds of the state are of rather limited extent. They form small but thick basins, often quite numerous and interlocking with one another. As distinguished from the other fields the Mystic coal has a wide geographical extent. It is known to extend almost continuously over an area nearly fifty miles long and at least forty miles wide, covering nearly all of Appanoose and the adjoining portion of Lucas and Wayne counties, in Iowa, and Putman and Schuyler counties, in Missouri. The associated beds are spread out in even sheets which appear to have a slight inclination southwestward. In the northeastern portion of central Appanoose the coal is exposed near the surface in the bluffs along all the larger streams, where it can be readily worked by drifting, or easily reached by shallow shafts. To the west and south it becomes more and more deeply buried until at Centerville it is mined at a depth of 125 feet. At Numa and Jerome the shafts are 150 to 160 feet deep; while at the west county line and at Seymour, in Wayne county, it is necessary to go a distance of nearly 250 feet in order to reach the seam.

In arrangement, the Mystic coal is well adapted to the long wall mining method, which under favorable circumstances is very much more economical than the ordinary

room and pillar plan. The roof is remarkably good and a short distance above the coal is a thick bed of lime-rock. The two, thin, persistent clay seams running in the coal throughout its range enables the coal to be parted readily. The amount of shale and fire clay removed in mining the coal and making the entries of the requisite height is ample for packing or "gobbing." In those mines which have been worked on the long wall plan the results have been exceptionally good. The method is coming more and more into use throughout the district and is rapidly taking the place of the more expensive room and pillar plan. At the present time, however, it may be said that the majority of the mines in the county work upon the room and pillar plan, though in some cases a somewhat modified plan is adopted which is called the "semi-long wall."

The excellent character of the roof and the presence of fire clay of considerable thickness as the floor, allow the use of the various forms of mining machinery, some of which are more or less dependent upon these factors for their successful operation. The machines at present used are chiefly those of the Harrison, Legg and Mitchell types and the Stanley Header, all of which have given good satisfaction.

While the Appanoose coal field is known to be very regular geologically in its arrangement, there are, nevertheless, some "troubles" encountered in different places. They are chiefly normal faults which, however, do not greatly interfere with mining operations. "Horsebacks" and "cut-outs" are also sometimes met with; the latter especially where the coal comes up near the surface. These "cut-outs" are chiefly due to preglacial erosion, the coal and the associated strata having been removed

and the cavities and depressions filled up with glacial débris. Some of the more important of the different kinds of "troubles" will receive consideration in connection with the descriptions of the mines in which they occur.

Moravia.—This is about the only locality in the northeastern corner of the county where coal has been mined. East of the village for a couple of miles along Mormon creek a number of country banks have been opened at various points. The vein mined appears to be the same as the Mystic coal, but this supposition has not as yet been fully substantiated. The thin clay seam at the typical locality is here said to be four inches in thickness. Although no mines of any consequence have been opened east of the Chariton river except in the vicinity of Dennis, the entire area may be well supplied with veins of workable coal, but in this case the beds probably lie some distance below the horizon of the Mystic seam.

Milledgeville.—There are no railroads nearer Milledgeville than eight or ten miles, and consequently the coal that is mined is largely for local use. The coal vein is doubtless the same as that at Centerville. It is exposed at a number of places along the Chariton river both above and below the Milledgeville bridge and is also said to outcrop on the South Fork of the Chariton near Griffinsville. The nearness of the vein to the surface enables it to be worked readily. Most of the mines now in operation are along the south branch of the river two to four miles south and southwest of the town. West of Milledgeville, about two miles, is the old Morland mine, now known as the Young No. 3. It was not operated for a number of years, but was recently reopened through a change of ownership. The section here is:

FEET.	INCHES.		
2	6		6. Limestone, gray, fossiliferous.
1	6		5. Shale, bituminous.
1	3		4. Coal.
	2		3. Clay parting.
	9		2. Coal.
2			1. Fire clay (exposed).

Figure 173. Coal Bed at Young Mine. Milledgeville.

Near the west county line, four miles directly southwest of Milledgeville (Tp. 70 N., R. XIX W., Sec. 30, SW. qr., SW. $\frac{1}{4}$) is located the Mosby shaft. A mile directly east of this place, on the river bank, are several openings which are now deserted. The principal ones were the Phillips and the Bennet mines. In the extreme northeastern corner of the same section is the Gurnsey slope. The Fenton mine is one of the largest openings in the vicinity. The coal was formerly taken out through two shafts, but at present a slope is in use. Two miles directly south of Milledgeville and in the immediate neighborhood of Griffinsville, are two shafts, both about fifty feet in depth, which are known as the Young mines. A short distance south of Griffinsville several small openings have been made in the valleys of the branches leading into the South Chariton river. Two miles northeast of Walnut City were also a number of openings, the most important of which were the Foster bank and the Nash shaft, neither of which is now in operation.

Walnut Valley.—This stream enters the county at a point midway between the north and south extremities of the western limit. It flows northeasterly about fifteen miles into the Chariton river. The C., M. & St. P. railroad

runs down the valley, crossing the Chariton and thence up Buck creek. For nearly the entire distance coal is mined to a greater or less extent; the entire valley forming almost one continuous mining camp now known by the different names of Jerome, Diamond, Brazil, Mystic, Orrsville, Rathburn, Clarksdale and Darbysville. Along the stream the Mystic coal crops out in numerous places and is mined by means of drifts. Away from the immediate vicinity of the water course the same vein is reached by means of shafts. The first mine met with in passing down Big Walnut creek east of the west county line is the Houser opening (Tp. 69 N., R. XIX W., Sec. 32, SE. qr., SE. ¼). The coal is of the typical Mystic seam and has the normal thickness.

Two miles eastward and about a mile from the creek is the village of Jerome, where a number of openings have been already made and where more mines will soon be opened. Just east of the town is the Big Four mine (Tp. 68 N., R. XIX W., Sec. 2, NW. qr., NW. ¼). This shaft is 125 feet deep. A mile directly north of the latter place is the Gladstone shaft. At this place the upper limestone was not encountered in sinking the shaft, but a short distance away it was found in place when putting down the air shaft, thus indicating that preglacial erosion had acted quite vigorously, though not operating sufficiently deep to cut out the coal. The thickness of the seam is thirty-three inches, with good "slate" roof and fire clay floor, the latter being a foot or more in thickness. Like in other mines of the vicinity, the faults encountered are chiefly slight slips which seldom interfere with mining operations. The Gladstone company is sinking another shaft, No. 2, about half a mile west of the town. A mile north of the village is the Knight mine, a local shaft forty

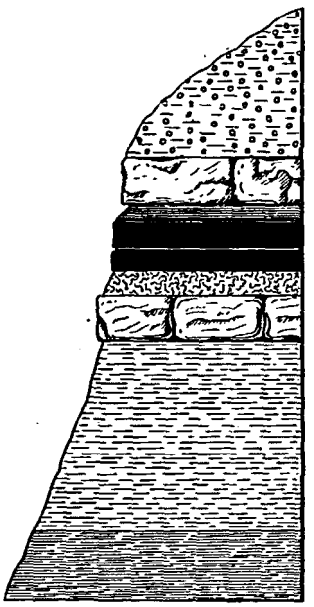
feet deep and situated directly on the creek. Near by is the opening of the old Morris bank, formerly worked for local use. Three miles north of Jerome, on the ridge on the opposite side of the creek near the station of Plano, coal was formerly mined at a depth of about ninety feet.

About four miles northeast of Jerome, and within two miles of Mystic, is an important mining locality known as Brazil. The Keokuk and Western railroad is here built along the branch flowing northward into the Big Walnut. Coal crops out along this stream at a number of places and has been worked by means of slopes for many years, the annual production being quite large. Between Jerome and Brazil the Hazelton shaft reaches the coal at a depth of about seventy feet. Tipton No. 1, now operated by Campbell and Phillips who also work two other mines in the vicinity, known as Tipton Nos. 3 and 4, is a slope, and has been worked back into the hill for a distance of nearly a mile. The other two are shafts opened near the crossing of the C., M. & St. P. and K. & W. railways by the Phillips Fuel Company, but have not been worked quite so extensively. Just south of the Tipton No. 1 is the Phœnix mine; and in the same neighborhood are several others, of which the Silknetter and the Philby and the Walnut Creek are the most important. The Walnut Block Coal Company is the most extensive operator in this vicinity, working three slopes. Southeast of Brazil at a switch called Laneville, on the Keokuk and Western railroad, is the Lane shaft, seventy feet deep, which has been operated for some years. Northeast of the village, about half a mile, is the small mine known as the Campbell slope, which is worked chiefly for local trade. The Eagle Coal Company operates a small local mine near here.

Mystic is probably the most important mining center in the valley. In the immediate vicinity of the town the coal is reached by means of slopes or drifts, but both east and west of this point shafts are necessary. Besides the leading mines now in operation there are a few small openings. Two miles southwest of here near the K. & W. crossing, is the Peerless No. 4, a shallow shaft. A quarter of a mile east are two mines about twenty-five feet deep known as the twins. They are the Peerless Nos. 5 and 6. A half a mile still farther east is the Raven mine, formerly known as the Silknetter No. 2. Immediately north is the Brown and Bowers slope, operated by a Kansas City firm. A short distance west of this is a new and well equipped slope belonging to the Columbia Coal and Mining Company. Still farther west, about two and a half miles from Mystic, the Mystic Fuel Company are developing a large area in which several mines will soon open. At Mystic station, opposite the depot, is the Lone Star mine (Tp. 69 N., R. XVIII W., Sec. 17, SW. qr., NE. $\frac{1}{4}$). The coal crops out and is reached by means of a slope. The vein is worked by the "semi-long wall" method, the props being left to protect the main roadway while the face of the work is carried on in the usual manner. A section of the bluff is shown in figure 174.

Immediately east of the depot is the large slope of the Iowa-Missouri Company. A short distance northeast of Mystic (Tp. 69 N., R. XVIII W., Sec. 16, NE. qr., NW. $\frac{1}{4}$) are the Lodwick mines, two slopes on the opposite sides of a small ravine which opens into the Big Walnut, just east of the town. A new double track slope is being driven so that the two mines may be worked as one by cross entries. In the development of the mine a glacial channel has been encountered. It was filled in with clay,

boulders and other drift material. The channel has been traced in a northeasterly direction for some distance, and is probably the same interruption which was met with in the old "Sandbar mine," which was located immediately



		FEET.	INCHES.
10.	Drift	12	
9.	Limestone, heavily bedded, gray, fossiliferous	2	10
8.	Shale, bituminous, fissile	1	
7.	Coal	1	6
6.	Clay parting		2
5.	Coal, with some pyrite near base	1	
4.	Fire clay	1	6
3.	Limestone, heavily bedded, fossiliferous	2	10
2.	Shale, gray, clayey	11	
1.	Shale, blue, clayey (exposed to water level)	4	

Figure 174. Bluff on Walnut Creek. Mystic.

southeast. The width of the channel, as revealed by working, is in the neighborhood of 1,200 feet. Traces of this channel or its branches have been found in other parts of the mine, but the coal has not been cut out.

East of Mystic, on the south side of the creek, are a number of openings which collectively are known as the Turkey river mines. They include the Orr No. 1, the Arnott, and slopes Nos. 2, 3 and 7, the latter being a new opening just east of the others, belonging to the Peerless Coal Company.

Two miles east of Mystic (Tp. 69 N., R. XVIII W., Sec. 15, NE. qr., NE. $\frac{1}{4}$) is the Clarke shaft, seventy feet

deep. A short distance northeast of it is the Orr No. 2; to the northward about a mile is the Star shaft, ninety feet in depth; while still farther in the same direction, near the point where the C., M. & St. P. railroad crosses the Chariton river, is the Darby mine, with the Superior Block mine on the opposite side of the river, half a mile distant.

The vein of coal which is worked by all of the mines just mentioned is exposed on Snort creek and in Chariton river, north and northeast of Centerville. It was formerly mined at Dennis and is well exposed near the old mill at that place.

Another important mining center of Appanoose is around the county seat, Centerville. About four miles north of the town, at a place called Forbush, there is located the Whitebreast No. 19. In this mine are seen:

FEET.	INCHES.		
2	6		6. Limestone, gray to black, with pyrite in lower part.
1			5. Shale, gray to black.
1	5		4. Coal.
	2		3. Clay parting.
1	2		2. Coal.
1	6		1. Fire clay (exposed).

Figure 175. Coal Seam at Whitebreast No. 19. Forbush.

It is one of the largest and best equipped mines in the county, and employs a large number of men. The coal is worked by the long wall method, the Stanley Header and other mining machines being used.

In the north edge of the town is the new Frisby shaft which will soon be in operation. Just west of the town,

at Relay, is the Centerville shaft, one of the most important mines of the county (Tp. 68 N., R. XVIII W., Sec. 35, NE. qr., NW. $\frac{1}{4}$). Coal in this vicinity has been mined for more than thirty years near the old site of Talbot mill. In the northern part of the town is the Monitor shaft which is thirty feet deep and which operates largely for local trade at Centerville. Directly east of the town (Tp. 69 N., R. XVIII W., Sec. 31, SE. qr., SW. $\frac{1}{4}$) is the Star, a small mine.

In the southeastern part of town, at the crossing of the K. & W. and the C., R. I. & P. railroads, is the Standard shaft, and a little farther eastward is Diamond No. 1, a large and well equipped mine. In the southwestern part of town, on the K. & W. railroad, is the Scandinavian mine, which has a shaft 100 feet deep; and a short distance north of it is the small shaft operated by the Happy Coal

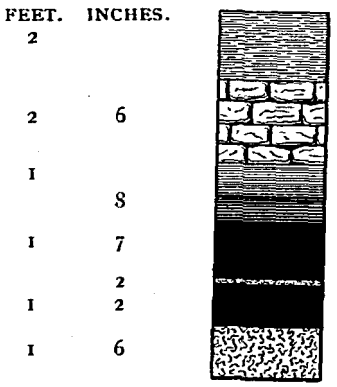


Figure 176. Base of Diamond Shaft No. 1. Centerville.

Company. The National mine, southeast of the Scandinavian, is one of the oldest and most important mines in the vicinity.

Directly south of Centerville a couple of miles is the Anchor No. 2, which has recently been opened. West

of it a mile and a half is the Eldon No. 2, belonging to the Eldon Coal Company of Ottumwa.

Southwest of Centerville five or six miles is the station of Numa, on the southwestern branch of the C., R. I. & P. railroad. There are two openings at this point, the principal one of which is the Diamond No. 2, a shaft 145 feet deep. A section at the bottom of the pit is indicated in figure 176. The Coal Valley mine just south of the town is a local shaft.

Cincinnati.—This is a station, on the southwestern branch of the C., B. & Q. railroad, which is rapidly increasing in importance as a coal center. The coal seam at this place is reached at depths varying from 60 to 120 feet. The roof is usually quite good. There are three mines in active operation and several others are making preparation to open shortly. North of the station half a mile is a small mine operated by the Cincinnati Coal Company (Tp. 67 N., R. XVIII W., Sec. 34, SW. qr., SW. $\frac{1}{4}$).

East of the town about a mile is the Thistle mine. The strata exposed are:

		FEET.	INCHES.
7.	Shale, black, highly carbonaceous		6
6.	Coal	1	9
5.	Clay parting		2
4.	Coal	1	
3	Clay, with pyrite		1
2.	Coal		8
1.	Fire clay (exposed)		6

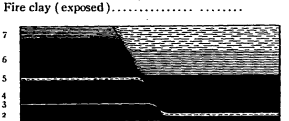


Figure 177. Fault in Thistle Mine. Cincinnati.

The section at this place also shows a small fault, one of many found in the mine. Few are of very great extent.

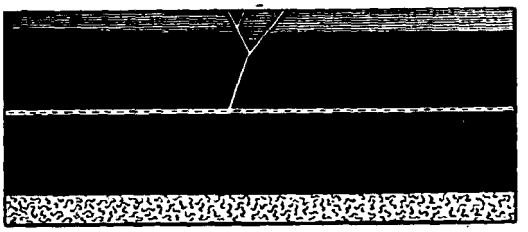


Figure 178. "Wedge" Fault in Thistle Mine. Cincinnati.

Another fault is one in which a V-shaped portion of the coal has been depressed five inches. The seams are filled with clay which contains pyrite. The disturbance

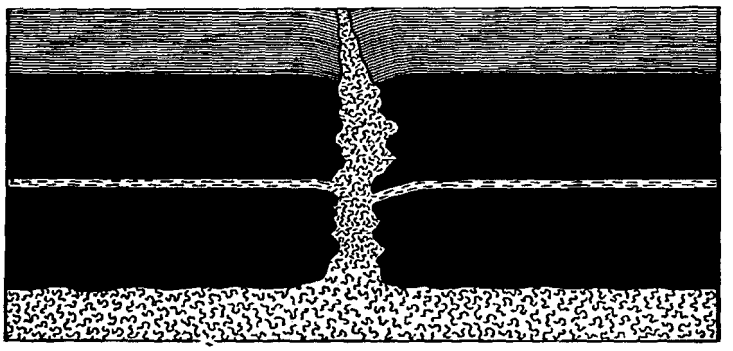


Figure 179. Fissure in Seam at Thistle Mine. Cincinnati.

does not extend into the lower bench of coal. A clay fissure is also shown near the same place. (Figure 179.)

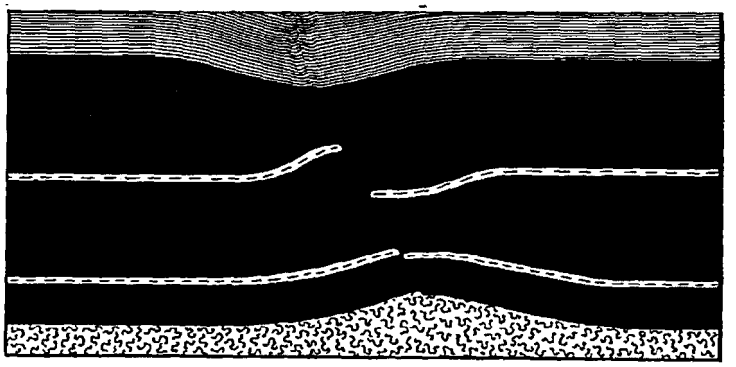


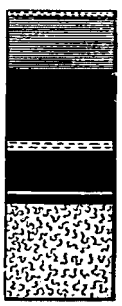
Figure 180. "Pinch" in Appanoose Mine. Cincinnati.

FEET.	INCHES.		
57		11.	Drift.
22		10.	Shale, gray to black, varying in character and hardness.
3		9.	Limestone, thinly bedded, gray, fossiliferous.
7		8.	Shale, black, with pyrite in part.
4		7.	Limestone, gray, heavily bedded.
1	4	6.	Shale, black, fissile.
1	8	5.	Coal.
	2	4.	Clay parting.
1	3	3.	Coal.
2		2.	Fire clay.
5		1.	Limestone, hard, heavily bedded (exposed).

Figure 181. Section of Albert Shaft. Cincinnati

Directly south is the Hyatt mine, a shaft owned by a company at Saint Joseph, Missouri. At the edge of the village is the Appanoose mine, which is somewhat troubled with preglacial channels. In this mine a small "pinch" is shown, as represented in figure 180. Southwest of this shaft about a mile is the Albert mine, and a little farther in the same direction is the Streator mine. The section of the former shaft is shown in figure 181.

Three miles south of Cincinnati the coal crops out at numerous places in the bed of a small stream. Near the next station is the Pearl City mine. The coal bed shows the following association of strata:



FEET.	INCHES.	
	2	8. Shale, drab, clayey (exposed).
1	2	7. Shale, black, highly bituminous.
1	6	6. Coal.
	3	5. Clay parting.
	10	4. Coal.
	1	3. Clay parting.
	2	2. Coal.
2		1. Fire clay (exposed).

Figure 182. Coal Bed in Pearl City Mine. Four Miles South of Cincinnati.

Farther southward in Missouri, at Mendota and Blackbird hill, coal is also extensively mined from the same vein. Six miles west of Cincinnati, at Livingston, there is a mine which has been operated for eighteen or twenty years, known as the Parker shaft. It is 110 feet deep and takes out sufficient coal for all local purposes.

Hilltown.—In the southeastern part of Appanoose coal has been mined since the first settlement of the county. The seam crops out in the east bank of the Chariton river at a number of places, and was mined at a place formerly known as Hilltown, two miles directly south of Dean station, on the K. & W. railroad.

At present there are only four mines at this point on the Iowa side of the line, though there are several more in operation a short distance south in Missouri, just west of Coatsville. The Dickinson mines are the most important operating here. They are two in number and are located half a mile south of the bridge (Tp. 67 N., R. XVI W., Sec. 21, NW. qr., NW. ¼). One of these has been driven into the hill, a distance of 150 feet, and the other 140 feet. The section of the seam is:

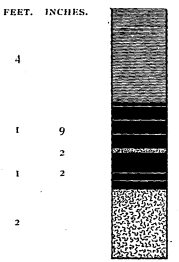


Figure 183. Seam in Dickinson Mine. Hilltown.

A large local trade is supported and some of the output is hauled to the railroad and loaded on the cars for shipment. A short distance north of this is the Heim mine and immediately east of it is the Tompson, locally known as the "Troublesome" mine. The latter has worked into a hill with two rather deep ravines on either side. In the course of the work the entry has been driven entirely through the hill, a distance of 700 feet.

Northwest of Hilltown four or five miles, at Exline, coal was formerly worked in a number of places.

Not far from the state line, in Missouri, two other veins of coal, below the seam exposed in the Chariton river, have been reported. They are one and one-half, and two feet in thickness and are about twenty feet apart, the upper vein being in the neighborhood of 100 feet beneath the vein just referred to.

At Foster, in Monroe county, a vein of coal is extensively mined at a depth of 200 feet. This probably extends over part of the adjoining portion of Appanoose county.

DAVIS COUNTY.

Although this county is surrounded by the leading coal counties of the state, it has never ranked as one of the more important of the coal producing districts. The entire county is doubtless underlain by valuable coal deposits, but because of the thick beds of drift there are exposures of Coal Measure strata in but a few places. The prospecting which has been carried on in the county has been in large part unsuccessful, in most places the drill holes not having penetrated through the glacial covering.

In the northeastern corner of the county the Lower Saint Louis limestone is found outcropping along the Des Moines river. This is also the only part of the county in which the Carboniferous limestone is exposed at the surface. Borings in various parts of the northeastern portion of the district show, however, that this limestone is at no very great distance beneath the surface. At Bloomfield, the county seat, it is found to be at a depth of about 230 feet, while westward and southward it becomes more and more deeply buried. Up to the present time the chief coal mining has been carried on in the northeastern corner of the county. Along Soap creek there are a number of coal exposures.

Near Laddsdale a coal vein outcrops which is from two to two and a half feet in thickness. It has been mined in this vicinity by drifts and shallow shafts for a long period of years. The Sickels mine, recently opened (Tp. 70 N., R. XIII W., Sec. 8, NE. qr., NW. $\frac{1}{4}$), works a seam of excellent quality. The lower eight inches is slightly firmer than the upper part, and of a dull black color. The section is:

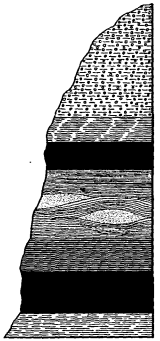
FEET.	INCHES.	
2		6. Sandstone, coarse, with pyrite concretions, (exposed).
	6	5. Shale, bituminous, fissile.
2	6	4. Coal.
	8	3. Coal, firm, ("smithing coal").
	3	2. Coal, impure, shaly, ("black-jack").
2		1. Fire clay, impure, gray, (exposed).

Figure 184. Coal Bed in Sickels Mine. Laddsdale.

Close by is the Dye drift, the entry penetrating the hill a distance of more than 600 feet. Considerable coal is taken out to supply an important local trade. A few years ago the owner became interested in coke and experimented upon the coal from time to time. A rude oven was built and some 300 bushels of coal burned. The samples of coke obtained were quite clean and firm, and were used by the brewery and iron works at Ottumwa. The coke was found to possess excellent heating qualities though somewhat soft. A short distance to the northeast is the Fite mine, a small drift, which is located on Soap creek and operates in the same vein of coal as the other two just mentioned. The coal is from thirty to thirty-two inches in thickness, quite regular and free from faults.

In the same vein are the Quigly, Dial, Dotson and other mines. There is said to be another vein of coal ten feet below the vein now worked. It was exposed while excavating for a bridge near the Sickels mine.

At Floris, three miles southwest of Laddsdale, numerous wells and borings show the drift to be at least 100 feet thick, and prospecting for coal has not been carried on much below that level. The deep channel of drift which appears to extend through this part of the county is fairly well marked and is known to extend from about



		FEET.	INCHES.
7.	Drift	10	
6.	Shale, bituminous	2	
5.	Coal	2	6
4.	Shale, bituminous, with bands and nodules of clay iron-stone, graduating below into next	6	
3.	Shale, firm, black, fissile	3	
2.	Coal	3	6
1.	Fire clay, gray, shaly in part	2	

Figure 185. Bluff on Soap Creek, near old Brown Cannel Mine. Carbon.

one mile west of Floris nearly to Laddsdale. A mile northwest of Floris (Tp. 70 N., R. XIII W., Sec. 15, NW. qr., NW. $\frac{1}{4}$) was the Howard shaft, which opened a vein of good coal four to six feet in thickness. This seam has never been mined extensively. South and west of

this place the coal is undisturbed, but a short distance to the east of the shaft a bore hole shows that drift continues to a point thirty feet below the calculated depth of the coal seam. Outcrops of Coal Measure strata are found a mile directly west of Floris, on a small tributary of Soap creek. Coal is also found three miles northwest of town, on the same stream. At this place two seams of coal are exposed in the bluffs. The lower seam is here made up, in part at least, of cannel coal. The bluff is shown by figure 185.

A few years ago a company was organized under the name of the Brown Cannel Coal Company, which took out some coal. The entry was driven a short distance and one or two rooms opened, but owing to financial troubles further development was prevented. A third seam, three and a half feet in thickness, was said to exist a few feet below, but this is not now exposed. This coal is of a dull black color, rather difficult to ignite, but burns with considerable heat. The section at the Brown Cannel mine is:

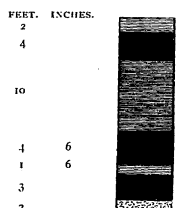


Figure 186. Seams at Brown Cannel Mine. Carbon.

On the opposite side of the creek there is a small drift known as the Dunn mine. The output is mainly

local, but a part of it is taken to Carbon and shipped over the Wabash railroad.

At Bloomfield, a few years ago, a prospect hole was put down to a depth of 500 feet. Though no careful record of the strata encountered was kept, it is known that three thin seams of coal six to eighteen inches in thickness were passed through. A thin seam of coal was also encountered in sinking a well eight miles southwest of the town. Six or eight miles northwest of Bloomfield, in the vicinity of Drakeville, a good vein of coal is said to have been struck recently in boring for artesian water, and a company has been organized to develop it. On Soap creek, northwest of Drakeville, outcrops of Coal Measure strata are known to occur. Thin seams of coal are also exposed in the bluffs of the stream in the southwestern part of the county.

The Hilltown district, in which considerable coal is mined, is only three or four miles from the Davis county line. The Mystic seam probably extends over only a small portion of Davis county. A section taken in the "Troublesome" mine at Hilltown, in Appanoose county, showed:

FEET.	INCHES.		
2		9.	Clay shale, gray, very hard.
1	2	8.	Shale, drab, clayey, ("clod.")
1		7.	Shale, black, fissile.
1	8	6.	Coal.
	2	5.	Clay parting.
	10	4	Coal.
	½	3.	Clay parting, with pyrite.
	2	2.	Coal.
2		1.	Fire clay, gray.

Figure 187. Bed in Troublesome Mine, near southwest Corner of Davis County, in Appanoose.

In the northwestern corner of the county deposits of coal also probably occur since extensive mines are in operation a few miles away on Soap creek, in Monroe county.

At Laddsdale is the shaft of the Eldon Coal Company, the coal mined lying across the line in Wapello county. The seam here is about eighty feet below the surface and consists of four feet of good, solid coal.

VAN BUREN COUNTY.

This county is one of the first in which coal was extensively mined in Iowa. Near the eastern margin of the Coal Measures the Lower Carboniferous rocks are found in the beds of all the larger streams. The upper beds of the Burlington appear to crop out in a few places, but the majority of the exposures show the Keokuk and Saint Louis limestones. The former was well exposed along the Des Moines river, from the southeastern nearly to the northwestern corner. It may also be found in the valley of the Fox river. It is the massive blue limestone which is so well exposed at Farmington, Bonaparte, Bentonsport, and Keosauqua. The Saint Louis limestone is found in the eastern part of the county, along the Cedar creek; in the northwestern part, along the Des Moines, and probably also crops out on the Fox river in the southwestern part of the county. The Coal Measures may be considered as underlying the entire county immediately beneath the drift, though at some points they are probably quite thin and do not yield a workable seam.

Cedar Valley.—The principal mining in this part of the county is on the south side of Cedar creek, a short distance from Hillsboro, near the Henry county line. Here is the Cox shaft (Tp. 70 N., R. VIII W., Sec. 24,

NE. qr., NE. ¼). Coal has been mined in this vicinity for upwards of thirty years. The principal opening is a drift which has been operated for more than a dozen years. The coal has a thickness of from five to six feet in places with a good shale roof and soft clay floor. The section at the bottom of the shaft is:

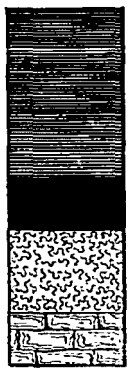


Figure 188. Base of Shaft at Cox Mine. Hillsboro.

The coal is at a depth of 100 feet from the surface. It crops out in the bed of the creek a short distance away. The coal in this vicinity is apparently disposed in comparatively small basin-like areas whose maximum thicknesses are centrally. In all directions the seams dip toward the middle. In the same neighborhood are a number of other small openings, among which are the Yardus, the Taylor and the Rice mines. These are worked only during the colder months of the year.

Near Birmingham, in the north central portion of the county, coal is known to exist, but no mining is carried on at the present time.

Des Moines Valley.—The principal mining in the county is done in the immediate vicinity of the Des Moines river. In the northwestern part, near Selma, coal has been mined for many years. The principal opening on the south side

of the river is the Lafever, a mile below town. The section here is:

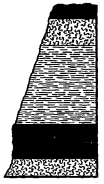


Figure 189. Coal Beds at Lafever Mine. Selma.

East of Selma a couple of miles several mines have been opened, the principal one being the Hinkle. The coal is three to three and one-half feet in thickness, with a good roof of black shale. Not far away is the Overtaff, where two seams of coal are exposed, one three feet and the other one and a half feet in thickness. Along Lick creek, northeast and east of Douds station, several mines are in operation. On this creek, near the Douds mine, the following section is exposed:

Figure 190. Section of Bluff at Douds Mine. Douds Station.

		FEET.	INCHES.
11.	Shale, argillaceous, blue, exposed.	10	
10.	Coal		5
9.	Shale, arenaceous, containing plant remains		10
8.	Coal		6
7.	Shale, arenaceous, becoming argillaceous below	3	
6.	Coal		6
5.	Sandstone, ferruginous, hard	1	
4.	Fire clay	1	2
3.	Shale, black, fissile, containing nodular masses of bituminous limestone	2–5	
2.	Coal	3¼	
1.	Fire clay		7

At the north county line is the Beal mine (Tp. 70 N., R. X W., Sec. 6, NE. qr.). The coal is two feet in thickness, but is not mined at the present time. Three miles southward is the Mather mine, a new shaft showing:

		FEET.	INCHES.
7.	Drift, brown and red clay, and sand	37	
6.	Coal		7
5.	Sandstone, yellow	2	9
4.	Limestone, blue, compact	1	3
3.	Shale, bituminous below	23	
2.	Coal	3	
1.	Fire clay, (exposed)	1	

Three miles east of the mine mentioned is the Taylor bank (Tp. 70 N., R. X W., Sec. 14, NW. qr.). This mine is located in a limited basin, which has been worked more or less extensively for thirty-five years or more. South of the Taylor is the Yarger, and still farther southward is the Smith mine.

In the vicinity of Keosauqua coal was formerly mined in the bluffs at various points. West of the town, on the Chequest creek, a seam of coal from eighteen to twenty-four inches thick is seen in the bluffs. It was formerly operated for local use but at the present time no coal is being taken out. The same vein is apparently exposed at several places south of the town. Four miles southeast of Keosauqua and about two miles west of Bentonsport two seams of coal twenty-five feet apart are found. The principal mine in the vicinity is the Boyer (Tp. 68 N., R. IX W., Sec. 3, SE. qr., SW. $\frac{1}{4}$). The seam is about three feet in thickness and has been worked to some extent for local use. Northeast of Keosauqua, within two miles of Utica postoffice, several openings have been made in a seam of coal, most of it being removed by quarrying. The Downard, the Teal and the Warner are

the chief openings in this neighborhood. On Coates creek, north of Bonaparte, several mines exist, the principal one being the Whitman (Tp. 68 N., R. VIII W., Sec. 5, NE. qr., SE. $\frac{1}{4}$). The section at this place is:

FEET.	INCHES.		
2		10.	Drift.
1	5	9.	Shale, dark blue.
	5	8.	Coal.
2		7.	Fire clay.
	11	6.	Shale, drab or brown.
1	6	5.	Shale, dark, fissile.
1	8	4.	Coal.
	1	3.	Clay parting.
1	2	2.	Coal.
2		1.	Fire clay.

Figure 191. Seam at Whitman Opening. Bonaparte.

A mile and a half to the eastward is the Lydolph mine, where the coal lies near the surface and is reached by shallow shafts, drifts and quarrying. The seam is

FEET.		
6	7.	Drift.
3	6.	Coal.
2	5.	Fire clay.
18	4.	Shale, light colored.
2	3.	Shale, bituminous.
2	2.	Coal.
1	1.	Fire clay, (exposed).

Figure 192. Coal Veins in Well on Honey Creek, Bonaparte.

somewhat undulatory, but has a general slight dip to the northward. North of the Whitman mine are several other mines, chief among which is the Haywood. A

couple of miles to the northward is the Hawk mine which is adjacent to a small branch on which the coal crops out. Not far away is the Hawk and Lackey mine and the Alexander. Northeast of the latter about two miles coal crops out in the bed of a small stream on the Vale farm (Tp. 69 N., R. VIII W., Sec. 15, SW. qr., NW. $\frac{1}{4}$). The coal is from two to three feet in thickness. The section as shown at a well put down near this point shows another vein of coal below the one opened. (See Figure 192.)

In the southeastern corner of the county, near Farmington, several mines are in operation. The coal occurs in small basins, several of which on the north side of the river have been entirely worked out. The coal is about three feet in thickness. The Ketchum mine is located north of the town (Tp. 68 N., R. VIII W., Sec. 36, NW. qr., NW. $\frac{1}{4}$). A short distance from this mine the new Turner mine is being put down.