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IOWA COAL

By H. E. PRIDE

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FRONTISPIECE. MAP OF THE COAL FIELDS OF THE UNITED STATES. Not all the areas indicated on this map are coal producing. The areas outlined are underlaid with rocks which contain all the known coal deposits of this country. Oftentimes large areas of these rocks are barren and contain no workable coal seams. Taken from Vol. II of the Iowa Geological Survey Reports.

IOWA COAL

By H. E. PRIDE

INTRODUCTION

The importance of the Iowa coal industry as compared to the other industries of the state together with the growing realization that coal is not always going to be the plentiful, cheap and easily obtainable fuel that it has been in the past, has prompted this effort to make available for the citizens of Iowa, particularly grade and high school students, some of the most interesting and important information on coal and the Iowa coal industry to the end that this great boon which has been granted this commonwealth may be more intelligently used and conserved against that day when every deposit shall have been exploited and our descendants will be forced to seek sources of light, heat and power, not yet discovered or invented.

The United States Geological Survey reports that we mine annually ½% of the total coal supply. That means that within 200 years we will be practically without coal.

Long before all the coal in the United States is mined it will become so difficult to obtain and the demand will so far exceed the supply that its cost to the consumer will soar to levels now entirely undreamed of. Fifty dollars a ton for coal will probably not be unheard of by the grandchildren of the present generation. Anthracite is quoted at one-half that figure in Iowa now. It was only ten or fifteen years ago that one-fourth to one-third of all the coal mined in Iowa, the "fines" or "steam coal," was given away at the mines in order to get rid of it. Thousands of tons of these "fines" have been thrown into the waste dumps of the past because no one wanted them. Now this same steam coal brings as much a ton as the lump coal did formerly. It is not inconceivable that this same increase in value will continue in the future. It will probably be augmented by the fact that poorer and thinner deposits will have to be worked as the better ones are exhausted.

Little contained in this bulletin is new or original. Practically all this information has existed in some of the official documents of the state or state societies but which are seldom seen by the average citizen. The Reports of the United States Geological Survey, Reports of the Iowa Geological Survey, State Mine Inspectors' Reports, Iowa Official Register, Miners' Handbooks and the reports on file in the State Mine Inspectors' Office have all been freely used. Much credit is due Mr. L. E. Stamm of the State Mine Inspectors' Office, Dean S. W. Beyer of the Division of Industrial Science, Profs. S. L. Galpin and A. K. Friederick of the Mining Engineering Department, Prof. C. S. Nichols of the Civil Engineering Department and others for the assistance they have rendered in compiling this booklet.

MAN AND COAL

For many years after man became a fire-using animal he gathered all his fuel from the forests in which he lived. As time went on and civilization advanced the forests began to disappear and attention was turned to other sources of fuel supply. From the burning of wood man soon passed to the using of the stored up carbon of bygone ages in the form of coal.

Altho the use of mineral coal as a fuel is very ancient its mining on an extensive scale began only in a comparatively recent period. From the earliest times recorded in history, the Chinese have used mineral coal and have obtained illuminating gas from it. Accurate accounts of its properties were given by the Greeks as early as the fourth century B. C. Before the Christian era, coal was known to the ancient Britons who were using it in their forges at the time of the Roman invasion under Julius Caesar. From these early days when coal was used principally for smithing purposes its use spread and increased until about the middle of the eighteenth century when an unparalleled development of all industry took place, due to the invention of the steam engine.

"Coal," says Newberry, "is entitled to be considered as the mainspring of civilization. By the power developed in its combustion, the wheels of industry are kept in motion, commerce is carried on with rapidity and certainty over all portions of the earth's surface, the useful metals are brought from the deep caves in which they have hidden themselves, and are purified and wrought to serve the purposes of man. By coal, night is, in one sense, converted into day, winter into summer, and the life of man, measured by its fruits, greatly prolonged. Wealth with all its comforts, the luxuries and triumphs it brings, is its gift. Though black, sooty and often repulsive in its aspects, it is the embodiment of a power more potent than that attributed to the genii in oriental tales. Its possession is, therefore, the highest material boon that can be craved by a community or nation. Coal is also not without its poetry. It has been formed under the stimulus of the sunshine of long past ages, and the light and power it holds are nothing else than such sunshine stored in the black casket, to wait the coming, and serve the purposes of man. In the process of formation it composed the tissues of those strange trees that lifted up their scaley trunks and waved their feathery foliage over the marshy shores of the Carboniferous continent where not only no man was, but gigantic salamanders and mailclad fishes were the monarchs of the animated world."

ORIGIN OF COAL

Source of Materials. Common coal is one of the three forms in which free carbon is found. The pure, well crystallized variety of

carbon is the diamond; the massive form found in crystalline rocks, graphite; and the ordinary dull, brittle variety, coal.

Coal is largely made up of vegetable matter, which under great pressure or temperature or both, has undergone marked changes. These changes progress gradually. According to the amount of modification which has taken place we have, first the mass of vegetable matter, then peat, lignite, bituminous or soft coal, semi-bituminous coal, anthracite or hard coal, graphite and finally the diamond.

That the coal now being mined was once growing trees and plants is clearly shown by the plant remains which are often found in the coal veins and in the rock layers associated with them. The underclays and sandstones just below the coal seams often contain roots of the larger tree-like plants. The overlying layers of shale and sandstone are frequently crowded with leaves and stems of many kinds; broad, spreading branches of delicate ferns, bark and branches of huge, tree-like plants.

After plants are dead, if allowed to stand in the open air, they rapidly decay and go to enrich the soil on which they grew. If, however, these plants are covered with water they will not so decay. Under such circumstances a mass of vegetable matter subjected to an even temperature and considerable pressure is converted into mineral coal in a comparatively short time. This conversion has been noted in old mines where heavy timbers have stood for years under conditions similar to those just mentioned. An instance of this kind is the case of the Dorothea mine near Clausthal in the Upper Hartz Mountains in Germany where the wooden supports in an abandoned chamber of the mine had remained untouched for more than four hundred years. During this time the timbers had been under great pressure, thoroly soaked with water and completely shut off from the air. When brot to the light after their long burial these timbers were found to have been changed into true brown coal or lignite.

Such modification of wood can be brot about in even less time. A French Geologist, Daubree, by the treatment of wood with very hot water under pressure, has succeeded in producing a substance indistinguishable from ordinary anthracite coal. A German scientist, Seeland, reported in 1883 the case of the timbers supporting a steam hammer which had been completely changed to lignite within a period of but twenty years.

Conditions of Deposition. Geologists who have made thoro studies of the Mississippi valley tell us that long, long ago, centuries before the history of man began, during what they call the "Carboniferous Period of the Paleozoic Age," there was a slow, often interrupted, sinking of the land surface over the entire region between the Appalachians and the Rocky Mountains. In certain places, this long, slow sinking of the earth's surface is known to have brot the ancient seacoast many miles inland over the broad, level plains. The movement

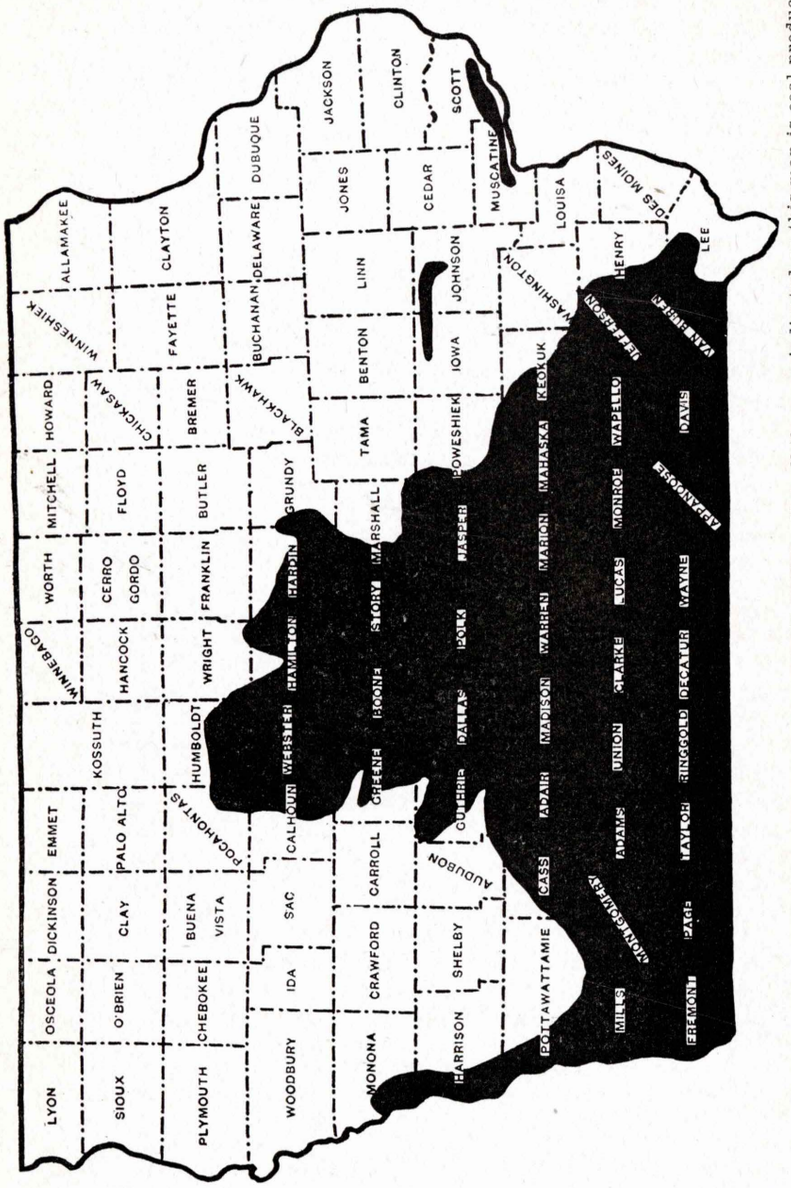

FIGURE 1. MAP OF THE COAL BEARING ROCKS OF IOWA. Not all the area indicated on this map is coal producing, and it is known that some of it never will produce any coal. The map indicates the distribution of those rocks in which coal may be found. In many parts of this area, particularly the southwestern, these rocks are known to be barren, that is contain no workable coal seams.

was very slow and often ceased for a period altogether. The seas being shallow and the climate similar to that of our present tropics, the conditions were unusually favorable for the existence along the coast of great swamps in which grew dense jungles of trees, plants and gigantic ferns. The effect produced was probably not entirely unlike that of the present mangrove swamps of southern Florida. Along the shore and inland on the low lying plains there were, no doubt, numberless depressions in which existed other swamps similar to those to be found at present in Northern Iowa and Minnesota.

Under such conditions these coastal swamps and inland marshes accumulated vast quantities of vegetable matter. As the trees and plants died they dropped into the shallow pools, there to be preserved by the water about their roots until buried deep under the trunks and branches of other plants which followed after them. As the land surface slowly sank, the accumulation of vegetable matter on the floor of the sea and the bottoms of the inland marshes became enormous.

As the masses of vegetable matter piled up they gradually became converted into peat, very similar to the substance to be found at the bottoms of our present Iowa marshes. A sudden quickening in the rate of sinking of the land surface permitted strong ocean currents to invade the swamps and cover the beds of vegetation with fine sediment. As the centuries rolled on this layer of sediment became thicker and thicker. A slackening in the rate of sinking of the land may have permitted a second swamp with its tangled vegetation to form on the grave of the first. In time this second swamp also was sunk beneath the water and buried in the silt and sediment of the sea. These various movements of the earth's surface with the resultant growth and burial of great masses of vegetable matter occurred no less than six times over that portion of Iowa indicated in figure 1.

As time rolled on, great pressure came upon these buried masses of vegetation from the increasing deposits of sediment over them. It is also probable that as they became more deeply buried they were subjected to increasing temperature. Thus all the conditions necessary for the changing of the vegetation into coal were present and the rich fuel supplies we are now enjoying, were formed. This change of vegetation and peat into coal is called bituminization.

In the process of bituminization, thru the loss of water and other changes the bulk of the vegetable mass is greatly reduced. The amount of this reduction varies considerably, depending upon the nature of the original swamp materials and the amount of transformation which takes place. It has been estimated that it would take nearly 2,000 acres of forest to produce one acre of coal three feet in thickness. In the case of the average Iowa coal bed it has probably taken no less than thirty feet of closely compacted material to produce a seam of coal four and one-half feet thick. Ordinary anthracite probably shrinks to less than one-tenth of its original bulk in the

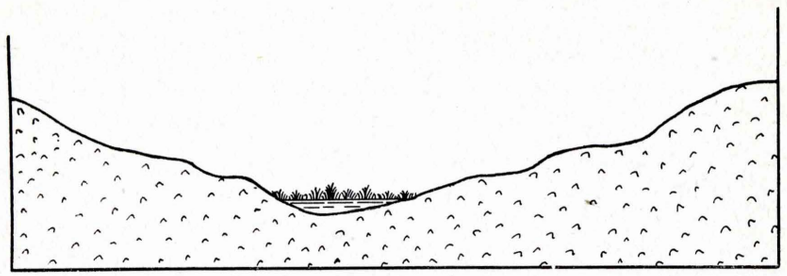

FIGURE 2. FORMATION OF A COAL SEAM. This sketch represents a cross-section of a small, prehistoric inland marsh such as may now be found in northern Iowa. Water accumulated in a depression in the land surface. Soon grass, rushes and shrubs began to grow in the shallow pool. Under climatic conditions such as existed in Iowa during the coal-forming age such vegetation attained a luxuriance to be found now only in tropical jungles.

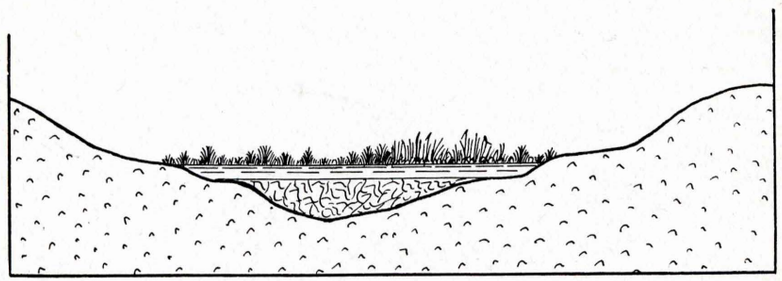

FIGURE 3. FORMATION OF A COAL SEAM. As the marsh plants died they fell into the water about their roots, there to be preserved from the destructive action of the air. Gradually a mass of dead vegetable matter accumulated on the bottom of the pool and the water level was raised as shown in the sketch. As the years rolled by this vegetable matter compacted and slowly changed to peat.

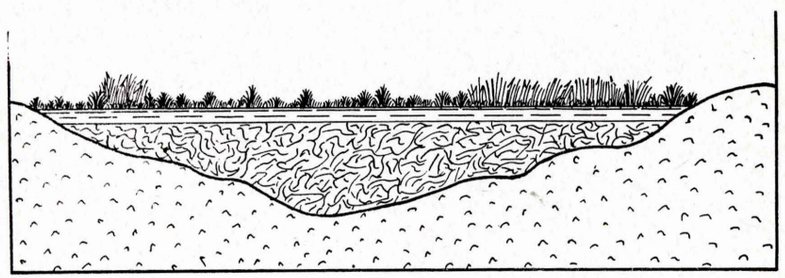

FIGURE 4. FORMATION OF A COAL SEAM. Here the marsh is shown filled with a tangled mass of vegetation and peat which has raised the surface of the water until it extends far beyond the boundaries of the original pond. Under the climatic conditions that existed in Iowa during the coal-forming period a marsh was not long in becoming filled with peat.

course of its formation. The reduction in the mass of a peat bed as it passes thru the successive stages of coal-formation, is mostly in a vertical direction.

Formation of a Coal Seam. As illustrating the action which probably took place in the forming of some of the present coal beds of Iowa, consider the case of an inland swamp similar to those which are still to be found in parts of Iowa. This marsh occupied some sort of a depression in the land surface in which water gathered with no good way of escape. The surface of such a marsh would be horizontal as indicated in figure 2. Under conditions such as existed in this section during the Carboniferous Period such a marsh would soon be crowded with plant growth which, as it dies, falls into the water and accumulates on the bottom. Gradually this vegetation will pile up and the level of the marsh will rise, as shown in figure 3. If the entire land surface is slowly sinking, or other conditions are right, water will continue to cover the surface of the marsh, and the depression will be slowly filled with vegetable matter which, under the action of the water, gradually becomes transformed into peat. The extent to which peat accumulates in marshes and swamps has been brot out on several occasions when railroads have attempted to cross such marshes in Northern Iowa or Minnesota. In the effort to obtain a firm roadbed piles have been driven down fifty to 150 feet without finding firm bottom.

If such a marsh is now sunk below sea-level, the ocean currents immediately start burying the mass of peat under layers of sediment. In time the load of the overlying sediment, which may have been converted into rock, becomes enormous and the mass is more and more compacted and compressed as it changes to coal, as shown in figure 5. In time, if conditions remain favorable, the peat becomes pure coal, first bituminous or soft and later anthracite or hard. When further movements of the earth's crust carry the land in which the coal is buried, above water again, as has happened in the Mississippi valley, this coal may be mined and used, just as Iowa coal is now being mined and used. As the thickness of the coal-bed is reduced it will be noted (see figures 4 to 6) that the mass takes on a shallow, saucer-like form. Such saucer-like "basins or swamps" are often encountered in the Iowa coal fields. The coal is of greatest thickness and purity near the center of the basin and "thins to the rise" around the edges, as the miners say. See figure 7. The Iowa Coal Measures, as the rock layers containing the coal seams are called, have passed thru only the first stages of the coal-forming transformation, for the product of all Iowa mines is bituminous or soft coal.

KINDS OF COAL

Commercial varieties of coal are classified principally according to the different proportions of fixed and volatile combustible matter pres-

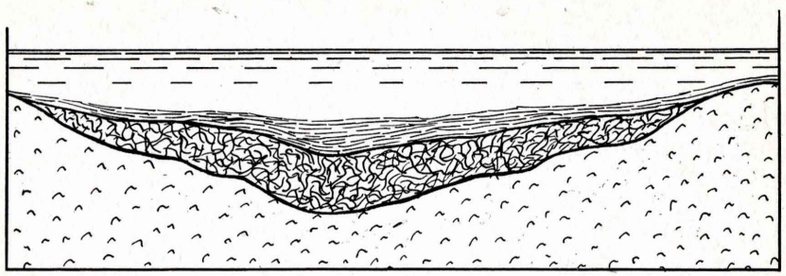

FIGURE 5. FORMATION OF A COAL SEAM. After the marsh was filled with peat it was sunk below sea-level as shown here and the waters of the ocean began burying the accumulated mass of peat under layers of fine silt, sediment and sand. As these layers of silt and sand became thicker and heavier the peat was compressed more and more. In time these overlying layers became transformed into solid rock, and the peat passed thru the successive stages of bituminization.

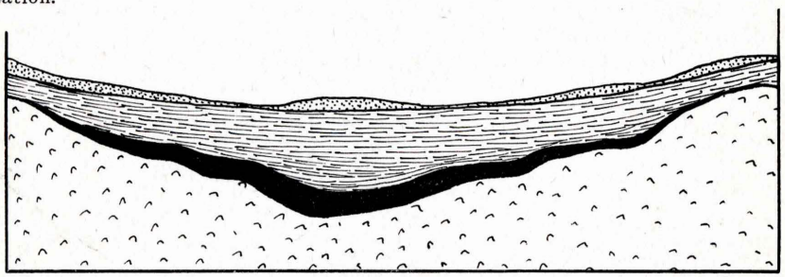

FIGURE 6. FORMATION OF A COAL SEAM. At the stage represented here the coal-forming action has been completed. The weight of the overlying earth and rock has become great enuf to compress the original mass of vegetation and peat to the thickness shown. Under the great weight, and, perhaps, some heat, the peat has been transformed into coal. The whole land area has been raised above sea level again and an irregular, saucer-like seam of coal awaits the coming of man to open up a coal mine and use the stored-up heat of the sun which caused the plants to grow in the prehistoric marsh so long ago.

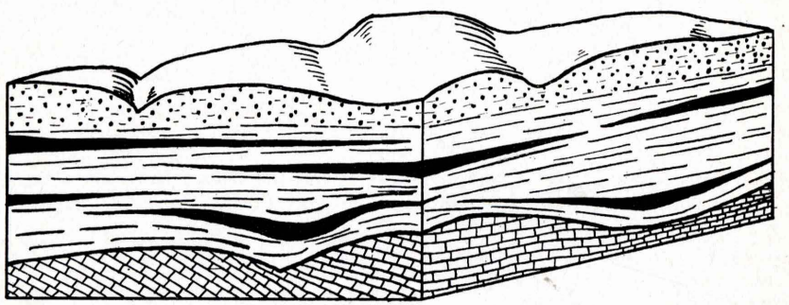

FIGURE 7. SECTION SHOWING ARRANGEMENT OF IOWA COAL SEAMS. This sketch represents a huge block cut out of the earth in one of the coal-producing counties of Iowa. It shows the saucer-like character of typical coal seams and their arrangement with relation to each other. Each vein represents a period in which the land surface was above or just at sea level and vegetation flourished. Each intervening series of rock layers indicates a period in which the land surface was enuf below sea level to allow the ocean currents to bury the accumulated vegetation. Some of these periods were very long indeed, for the ocean deposits sediment comparatively slowly.

ent, that is, according to the amount of solid and gaseous matter which will burn. The proportion of the volatile or gaseous material present determines the character of the coal, thus, pure graphite contains practically no volatile matter, anthracite or hard coal about 10 percent and bituminous or soft coal about 40 percent. With this method of classification the common varieties or classes of coal are determined.

Graphite. The pure, massive variety of carbon often found in crystalline rocks which have undergone great pressure and alteration at some time in the past, is termed graphite. It is used in making lead pencils and stove polish and as a lubricant. There is none in Iowa.

Anthracite. Anthracite or hard coal, contains a very small proportion of volatile material. It is very hard, heavy and has a bright, lustrous appearance. It ignites very slowly, burns with a blue flame and gives off little smoke. It is found chiefly in the Appalachian mountains, in this country. There is no anthracite in the Iowa coal fields.

Semi-bituminous. There are several varieties of coal with characteristics which place them somewhere between the true anthracite and the bituminous classes. These are called semi-bituminous.

Bituminous Coal. Bituminous or soft coal is much softer than anthracite. It contains much more volatile matter, burns with a yellowish flame and gives off quantities of dense smoke, especially when first ignited. Most Iowa coals fall into this class. They are, however, of three more or less distinct varieties.

1. Dry, open-burning furnace coal.
2. Cementing or coking coals.
3. Cannel coals.

Of these the first and second varieties are sometimes called cubical or block coals from their tendency to break into more or less regular cubes or blocks. The first kind is divided into fairly distinct layers separated by thin sheets of mineral charcoal. The second kind has much thicker layers and fewer partitions. It is melted by the heat of burning and fuses or runs together, forming one solid mass in the furnace. Such coal is used for the manufacture of coke and illuminating gas. In this process the coal is heated but not ignited. The heat drives off the gases and leaves the coal in the condition of anthracite except that as this change has taken place without pressure the mass is cellular and spongy. The gas may be used for heating and lighting purposes and the coke makes a very intense, hot fire, tho it is difficult to ignite, just as is true anthracite.

The third variety, cannel coal, is not plentiful in Iowa. It is characterized by a high percentage of gas with excellent illuminating qualities and more ash than other varieties of bituminous coal. It exhibits a peculiar lamination or arrangement of the layers which leads geolo-

gists to conclude that it was laid down in more open water than existed in most parts of the ancient coal marshes.

Lignite. Lignite or brown coal is a compact, woody or charcoal like material having many of the properties of common bituminous coal. It is very soft and crumbles easily. It contains a high percentage of gas and moisture, but by proper preparation a very serviceable fuel may be obtained. There are numerous beds of lignite in Northwestern Iowa, but they have never been considered of any great importance.

Peat.—Peat represents one of the first stages of coal formation. It consists of a tangled mass of vegetable matter which has accumulated under water, as in the marshes and lakes of Northern Iowa. With proper preparation and drying it becomes a fairly good fuel.

HISTORY OF COAL MINING IN IOWA

Strange as it may seem, the discovery of coal in this country belongs, not to the first explored sections along the Atlantic, but to the interior of the continent, to the immediate vicinity of Iowa. Coal was found in this section half a century before it was known to exist in the eastern states. The earliest record of coal in Pennsylvania is dated 1704, twenty years after Penn obtained his grants from England. Jesuit missionaries, in what is now the state of Minnesota, made record of the occurrence of coal as early as 1659.

The first distinct mention of the occurrence of coal in Iowa appears to be that of Featherstonehaugh who in 1835 descended the Mississippi in a canoe from Dubuque to St. Louis. At the mouth of the Rock River, on both sides of the Mississippi, he reports the occurrence of bituminous coal deposits. In the same year Albert Lea investigated the resources of the Black Hawk Purchase, comprising what is now eastern Iowa, and noted the presence of coal in many places.

Tho rich deposits of coal underlay most of the central and southern counties of Iowa, these deposits are so deeply buried that it is only in the deepest valleys that coal seams are exposed to view. For this reason the early explorers discovered coal first along the Mississippi, Des Moines and other rivers in the southern part of the state. How long before the advent of the white man the Indian had been using coal as a fuel is not known. The abundance of wood made unnecessary the use of coal by the early settlers until about the time this section became a territory, in 1838. The first mines were opened in the southeastern counties where there were the most plentiful indications of deposits. The industry then spread up the Des Moines river valley and finally out toward the southwestern corner of the state, where, tho the deposits are much thinner and not nearly so extensive,

the distance from coal-producing centers creates a good demand which makes the working of these small deposits highly profitable.

The story of the development of the coal industry in the various counties of the state contributes many pages to Iowa history. Space here will permit but a brief summary.

Van Buren County. No doubt considerable coal was used during the late 30's in Iowa, but most of this was gathered around the exposed seams with little attempt to dig far into the hillsides. The first real coal mining operations in this state were carried on by Lem Brattain near Farmington on the Des Moines river in the extreme southeastern corner of Van Buren county in 1840.

After a few years Mr. Brattain sold his mine to Samuel Knight, who carried on the business until 1848 or 1850. It was not until near the end of Mr. Knight's period of operation that there was a railroad into Farmington and so most of his output was sold to his neighbors and nearby villagers. However, some of his coal was hauled by team and wagon as far as Keokuk, twenty-five miles away. He also sold large amounts to the steamboats which then plied up and down the Des Moines river.

About 1850 Mr. Knight sold the mine to the "New York Coal Company," which worked the mine on what was, in those days, quite an unheard of scale. Forty to fifty men were employed about the mine, which was now connected by a switch with the Des Moines Valley railroad, since a part of the Chicago, Rock Island and Pacific system. The miners were paid about five cents a bushel or a dollar and a quarter a ton for digging the coal, which sold at the mine for $2.00 or $2.50 a ton.

Scott County. The pioneers in Scott county began using coal as a fuel about the same time that Lem Brattain opened his mine near Farmington. Sometime in 1840 the first coal bank was opened by a Mr. Wright near Jamestown, a few miles north of Buffalo on the Mississippi river southwest of Davenport. Buffalo and Jamestown have been the centers of the mining which has been carried on in that county since.

About 1860 John Morris came to Jamestown as manager of the John James mines. His coming marked the beginning of systematic coal-mining in Scott county. He was the first man in this district to sink shafts and raise coal from them by horsepower. Prior to 1870 all of the openings in this district were slopes or drifts driven into the hillsides, but since then most of the coal has been taken from shafts forty to 125 feet deep. Scott county produces very little coal now.

Appanoose County. A. M. Elgin opened the first mine in Appanoose county on Little Walnut creek, a mile and a half north of Mystic, in 1857. This "Mystic seam," as the vein mined here is called, is very easily worked, which explains the large number of mines that have been opened in this district. Probably no other county in the state has supported as many mines as has Appanoose. The first large mine at Mystic was opened in 1858 by Isaac Fuller and furnished

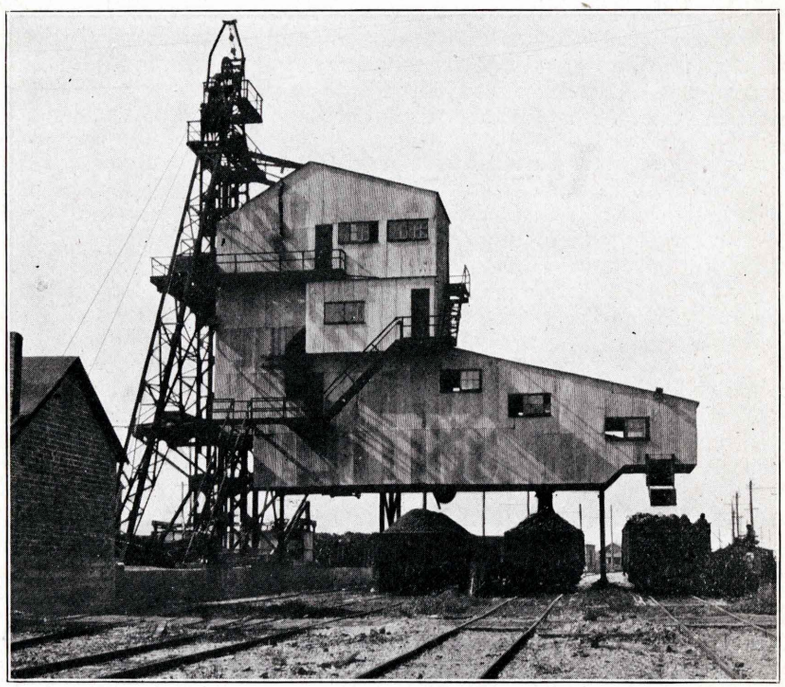

FIGURE 8. NORWOOD-WHITE COAL COMPANY'S MINE NO. 7 NEAR MORAN IN DALLAS COUNTY. This is a comparatively new plant and one of the best equipped in the state. The tipple and screening plant are steel, electric lighting is used thruout the underground workings and tho mules are now used, the mine is being laid out with the idea of using electric haulage as soon as it begins to produce at full capacity. A large bed of excellent coal, four to nine feet thick, is being mined.

most of the coal for Centerville for a number of years. In 1881 it was made a shipping mine, that is, it was connected with a railroad by a switch on which cars could be loaded. It has since been exhausted. The operations in the Mystic district were mostly of a local character until the Chicago, Milwaukee and St. Paul railroad was built thru Mystic in 1887. Then mining on a commercial scale began.

Wapello County. The high bluffs bordering the Des Moines river valley and the deep ravines opening into it in Wapello county exposed rich veins of coal to the early settlers, who were not long in availing themselves of the opportunity to readily obtain supplies of excellent fuel. Tho operations worthy of the term mining were not started here as early as in other parts of Iowa, Wapello long maintained a position as one of the principal coal producers in the state.

Monroe County. Altho Monroe has had fewer mines in operation than a number of leading counties, she has for many years held the supremacy as a producer and her average output per mine is probably larger than that of any other county in the state. C. A. White states that in 1868 small mines had already been opened along Bluff, Miller and Avery creeks and that the Cedar mines west of Albia were producing coal. The first report of the State Mine Inspector covering the years 1880 and 1881 states that there were then some thirty mines in operation in Monroe county employing 638 men. The deepest shaft then was 150 feet and located near Albia. The total production for 1881 is reported as 98,143 tons.

Lucas County. The early history of coal-mining in Lucas county is largely the story of the Whitebreast Fuel Company. The first development of any consequence in Lucas county was undertaken by William Haven, who in June, 1874, made a lease of lands eight miles west of Chariton on Whitebreast creek. He organized the Whitebreast Fuel Company and started prospecting. After "many trials, troubles and tribulations," on January 16, 1878, a five-foot four-inch seam of coal was struck at 250 feet below the surface and the career of the Whitebreast field was started, a field from which a greater tonnage was raised in a given time than from any other field in the state. An eighty-horsepower engine was used for hoisting coal and the first installation of electricity for mine-lighting in the state was made here. In 1880, 405 men and fifty-two mules were employed around the works and were producing 640 tons a day. Whitebreast mine No. 1 was the first mine in the state to adopt the plan of firing the blasting shots but once a day. This did away with explosions while the men were in the mine and kept the air pure for the men and mules.

Mahaska County. Mahaska county was one of the first counties in the state in which coal was known to exist, but for a number of years it was used for nothing but blacksmiths' forges. In 1847 Dr. D. D. Owen found a Mr. Morgan working a four-foot bed of coal in the bluffs along Muchakinock creek, three miles above Eddyville. In 1875 Messrs. W. A. and H. W. McNeil of Oskaloosa organized the Iowa Central Coal Company, one of the largest coal-producing companies Iowa has ever known.

Jasper County. Coal was discovered in Jasper county in 1847. It was mined in a fairly extensive way at Slaughter's coal bank eight miles west of Newton on the Skunk river as early as 1857. Mining on a commercial scale began in Jasper county in the 70's. The first shipping mine was Watson No. 1, four miles east of Colfax. William Snooks opened a shaft near Newton in 1886 and since then both Newton and Colfax have become important coal-producing centers.

Marion County. In 1856 the village of Coalport on the south bank of the Des Moines river in Polk township of Marion county was the most important coaling point for the river steamers between Eddyville and Des Moines. Here the first mines of any consequence in Marion county were opened up. With the cessation of navigation on

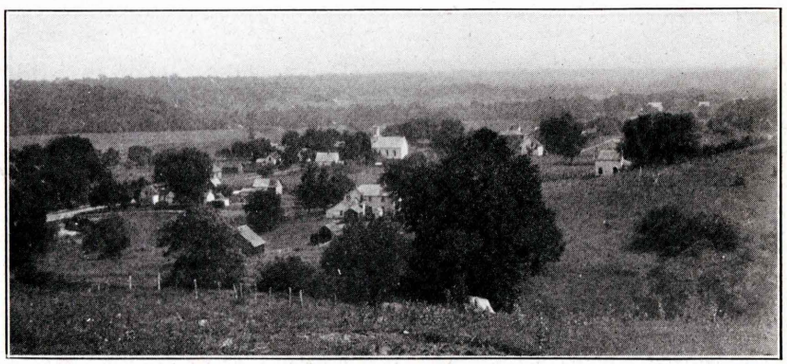

FIGURE 9. MOINGONA, ON THE DES MOINES RIVER IN BOONE COUNTY. About 1880 Moingona was one of the largest coal mining camps in the state but now the mines in that district have been abandoned and the place is practically a "deserted village" tho its location on a branch of the Northwestern railroad tends to keep it on the map.

the Des Moines river these mines closed down and Coalport does not even appear on modern maps. Tho coal deposits are rather extensive in Marion county, she has never ranked very high as a producer, principally because of the lack of railroads.

Polk County. The discovery of coal in this county is credited to the soldiers stationed at Fort Des Moines. The exact date of the discovery does not seem to have been recorded, but it was about 1840. The soldiers dug coal from a vein exposed in the river bank near the Center street dam, and also near Barlow Granger's south of the Raccoon river. The coal was used first by the blacksmiths at the fort. In 1843 Captain Allen and A. N. Hays opened a shaft and stone quarry on the banks of the Des Moines, but the coal was in very slight demand, as wood was plentiful.

Of late years Polk county has assumed a place in the front rank of coal-producing counties. In the matter of operation and equipment the mines of this county are second to none.

Dallas County. It was not until civil war days that coal was dug to any extent in Dallas county. Most of the early coal was taken from very thin veins, six to eighteen inches, near the surface. By 1878, however, the Chicago and Van Meter Coal Company had sunk a shaft 256 feet to a three-foot vein. In 1879, after the engine house at this mine had burned, entirely new machinery was installed thru-

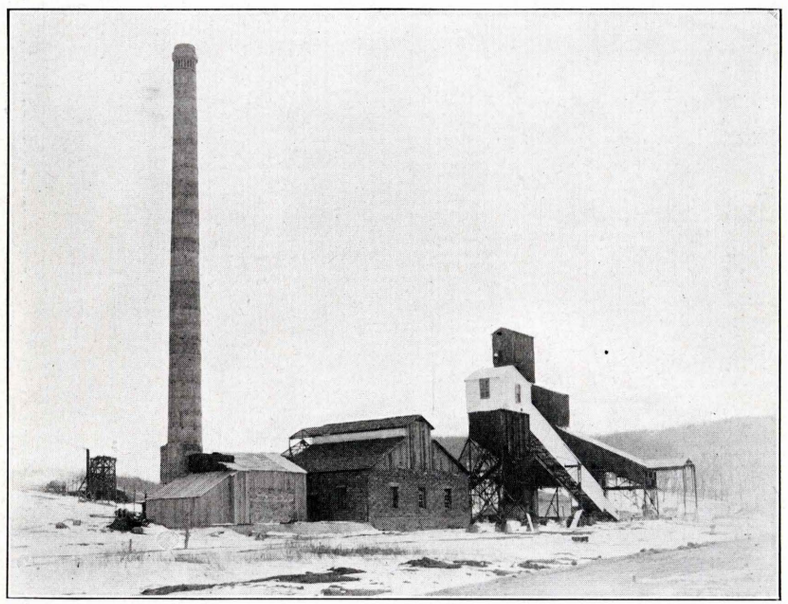

FIGURE 10. PLANT OF THE CONSOLIDATION COAL COMPANY'S MINE NO. 18, AT BUXTON IN MONROE COUNTY. This mine has long ranked as one of the large producers of the state. In 1919 it was the largest single producer in Iowa. This view shows the plant during construction.

out the mine. Steam hoist was used and compressed air machines were employed for cutting the coal. Dallas now ranks as one of the largest coal-producing counties of the state.

Boone County. Boone county early acquired a place of importance as a coal producer, a position which she yet holds. Tho coal was produced for the use of blacksmiths in the 40's, it was not until after the advent of the Chicago Northwestern railroad in 1866 that coal-mining was really taken up. The first shipping mine was a slope opened up in 1867 by T. N. Canfield and C. S. Taylor just west of Boonesboro.

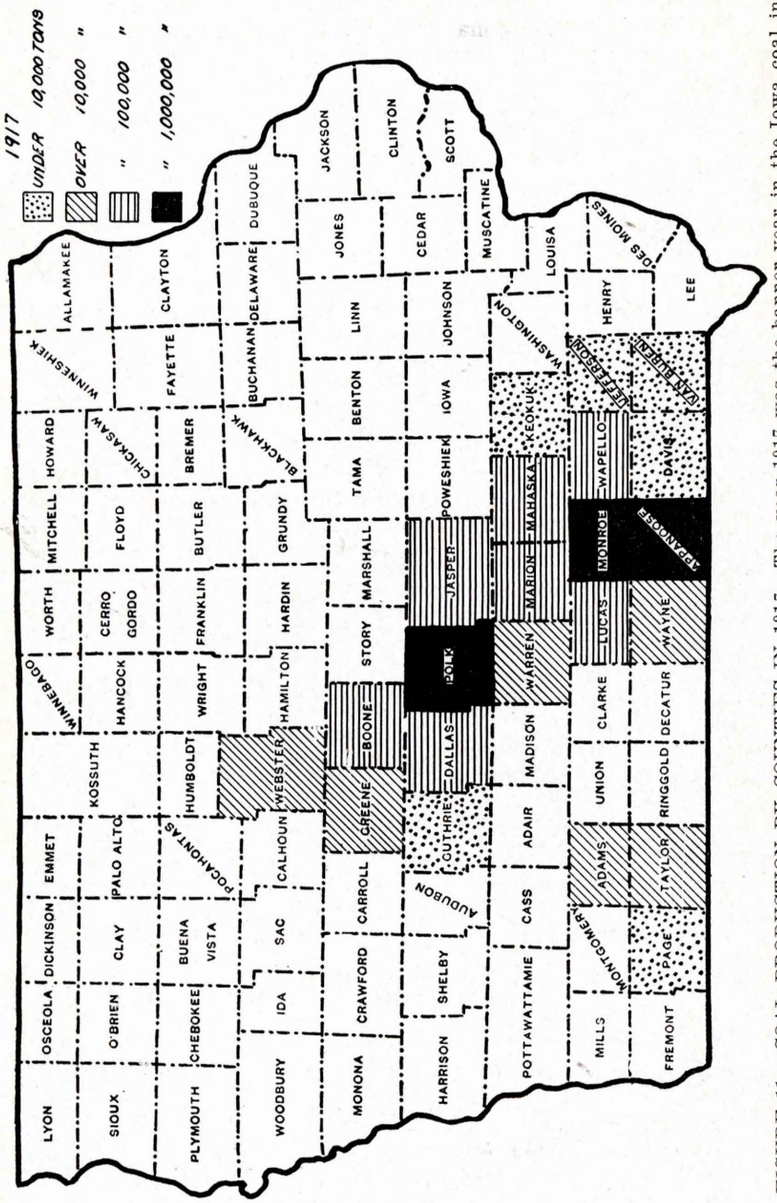

FIGURE 11. COAL PRODUCTION BY COUNTIES IN 1917. The year 1917 was the banner year in the Iowa coal industry. About four tons for every man, woman and child in the state were raised from the coal seams in that year. This map indicates where this coal was produced. The three leading counties, Polk, Monroe and Appanoose, produced about two-thirds of the total of over 9,000,000 tons for the year.

In the same year the Moingona Coal Company opened a mine at Moingona on the Des Moines river with Wm. Blythe as superintendent. Six mines were operated by this company and for some years their output amounted to 800 to 900 tons a day. For a number of years Moingona was one of the largest camps in the state and was the scene of great activity, but for twenty years now very little work has been done there.

Hardin County. Abram Grimsley, the first blacksmith in Hardin county, is credited with obtaining his fuel supply from the bed of the Iowa river near Eldora as early as 1851. Prior to 1854 S. D. Moran had been prospecting and mining on a small scale near Eldora and soon after that date James Buckner and Edwin Fuller began mining there. People came with teams from Cedar Rapids, Independence and Waverly, distances of 100 to 125 miles, to obtain coal from these mines, for there were no railroads in that part of the state at that time.

Webster County. Of late years Webster county has been a prominent producer of a good grade of coal, tho operations were not started until the late 60's. The first shipping mine was opened in 1870 on Holaday creek several miles below Fort Dodge.

Taylor, Page and Adams Counties. Altho the coal veins of southwestern Iowa are very thin, their regularity and wide extent have promoted mining operations and the distance from other coal fields has always insured a ready and profitable market. J. R. Foster was working an eighteen-inch bank on the East Nodaway two miles south of Henshaw in Taylor county in the early 60's. The first shipping mine in this county was opened in 1885 by Benjamin Anderson east of New Market on the Humeston and Shenandoah railroad, now a part of the Burlington system. Coal was hauled to Council Bluffs, Omaha and Nebraska City from the banks at Pinhook southeast of Clarinda on the Nodaway river in Page county as early as 1850. Tho it was not until the early 60's that any coal was dug in Adams county, this county has since been one of the principal producers of southwestern Iowa.

Coal beds are present under fifteen or twenty of the other counties in central, southwestern and southeastern Iowa, but mining operations in most of them have never attained very large proportions.

The year 1917 was the banner year of the last decade in Iowa coal mining. The reports for that year show that there was more coal raised from the Iowa fields than in 1918 by nearly one million tons and almost twice as much as in 1919. Over nine million tons, or about four tons for every man, woman and child in the state at the time of the 1910 census, were produced in that year. In 1918 war conditions cut down production materially and in 1919 the mines were

idle for about a month and a half during the early winter, the most active season of the whole year, due to a disagreement between the miners and the operators.

In 1919 the Consolidation Coal Company's mine No. 18 at Buxton in Monroe county was the largest single producer in the state. This mine, with a total of 498 men employed thruout the year, produced 599,712,000 pounds or 299,856 tons of coal of all grades, over 5% of the total production of all the mines of the state. This is at the rate

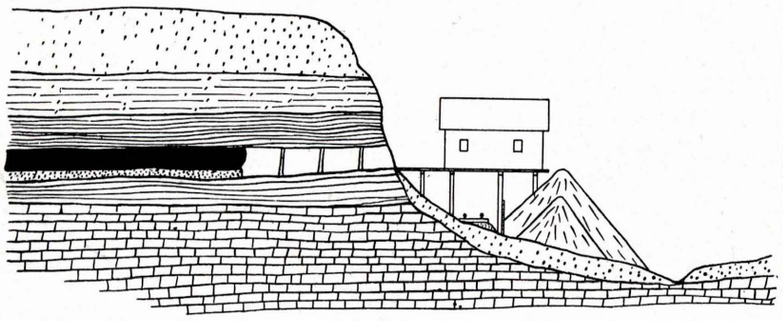

FIGURE 12. TYPICAL DRIFT MINE. This sketch shows the general layout and method of working a drift or slope mine. This sort of mine can only be operated, when the vein of coal "outcrops" or is exposed in a hillside. The coal is mined from the face of the seam, loaded into mine cars and pulled out of the slope or drift by mules or a hoisting engine located in the engine house at the pit mouth. The coal may be dumped directly from the mine cars into railroad cars below the trestle, when it is known as "run-of-mine" or it may be passed over gravity or shaker screens and the fine coal separated from the lump. The "gob" or waste material, stone, slate and sulphur, is dumped off the end of the trestle.

of 602 tons for every man employed about the mine. The Central Iowa Fuel Company's mine No. 2 in Lucas county was a close second with 217,169 tons produced with 360 men, or 603 tons per man employed. The Red Rock Coal Company's mine near Melcher in Marion county was third with 187,427 tons with 345 men, or 544 tons for each man. These three mines together produced nearly one-eighth of all the coal produced in the state. The individual outputs of only three counties in the state, Monroe, Appanoose and Polk, in that year exceeded that of these three mines taken together. See Table I and figure 11.

TABLE I.

Number of Mines, Miners and Tons of Coal Produced in Iowa Annually Since 1900.

Year	Mines	Miners	Tons
1900		13,041	5,117,285
1901		13,175	5,441,863
1902		13,002	5,514,206
1903		13,192	6,185,734
1904		16,315	6,214,379
1905		17,624	6,806,011
1906		16,825	7,017,485
1907	329	17,045	7,568,425
1908	333	17,312	7,155,435
1909	316	18,002	7,346,253
1910	297	18,261	7,222,480
1911	243	16,890	7,729,674
1912	260	16,215	6,820,828
1913	246	15,685	7,415,757
1914	258	15,834	7,312,734
1915	252	16,369	7,530,088
1916	243	15,195	7,217,979
1917	246	15,464	9,049,806
1918	239	14,563	8,219,315
1919	224	12,896	5,571,630

METHODS OF COAL MINING

It could hardly be said that the first Iowa coal used was mined. It was gathered from the exposed ledges or outcrops along the Des Moines river and its tributary streams. With pick and shovel the early pioneer dug the coal with little difficulty and little thot as to systematic procedure. During the summer while the farmers were busy with their crops the banks were practically deserted. During the winter months these same farmers became coal "operators" or "miners."

It is recorded that in the southern counties the hills and bluffs along the streams were "honeycombed" by the diggings of these early operators. A vein would be followed into the sidehill for a season. Sufficient timbering would be set up to support the overlying earth and rock temporarily. During the summer, when the "drifts," as such openings were called, were deserted, the roofs usually caved in and the next autumn new openings would be made. Such operations could hardly be called mining.

It was not long, however, until enterprising operators began to devote their entire time to supplying steamboats and towns, and later the railroads, with fuel and some of the openings became real drift mines. See figure 12. Later, when all available drift sites had been worked out, shafts were sunk from the uplands thru the overlying earth and rock to the buried coal seams. Today practically all the mines in the state are shafts, of the sort illustrated in figure 13.

Two methods of removing the coal from the buried veins are used in the Iowa fields today. They are known as the room-and-pillar and

the longwall methods. The room-and-pillar method of mining coal is one of the oldest systems known. As long as no thot was given to the complete exhaustion of coal deposits and the owner of a coal mine was not considered to owe any obligations to the general public, this system was a great favorite. Now, as it becomes possible to foresee the day when all known coal beds will be mined out and consumed, any system of mining which is as wasteful of a nation's resources as the room-and-pillar method will hardly be used.

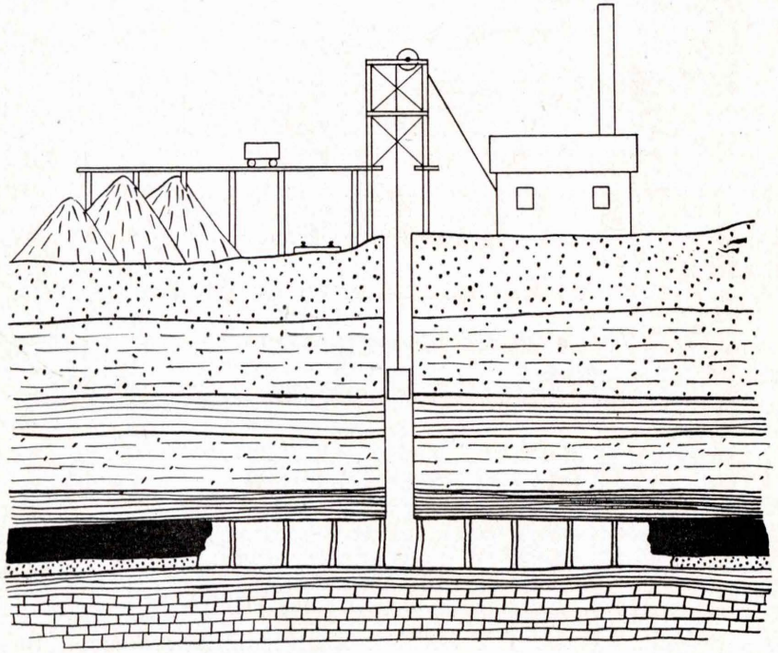

FIGURE 13. TYPICAL SHAFT MINE. If the coal seam to be mined does not outcrop it is reached by means of a hole or shaft sunk from the surface thru the overlying earth and rock. The coal is mined from the face of the seam and loaded into mine cars which are hauled to the shaft by mules or electric motors. These cars are then hoisted to the surface by an electric or steam hoisting engine. Here the coal is dumped directly into railroad cars from the tipple, as the framework over the shaft is called, or passed over screens which separate it into the different sizes. Every mine has its "gob dump" of waste material which comes out with the coal.

The weight and character of the overlying load of earth and rock that must be supported when the coal is removed and the character of the floor or bottom under the coal, control in a large measure the method of mining to be used. In fact, the character of these factors is sometimes such that the enclosed coal seam cannot be mined at all. If the material immediately overlying a coal seam is loose and permits large quantities of water to pass thru it, the seam will be mined with considerable difficulty. The roof may be satisfactory, but the

floor may be soft and fluid so that as soon as any coal is removed the weight of the surrounding material on this soft bottom causes it to flow into the opening made by the removal of the coal. Or if it is not fluid it may be so soft as to offer no foundation for timbers which are put in to support the roof.

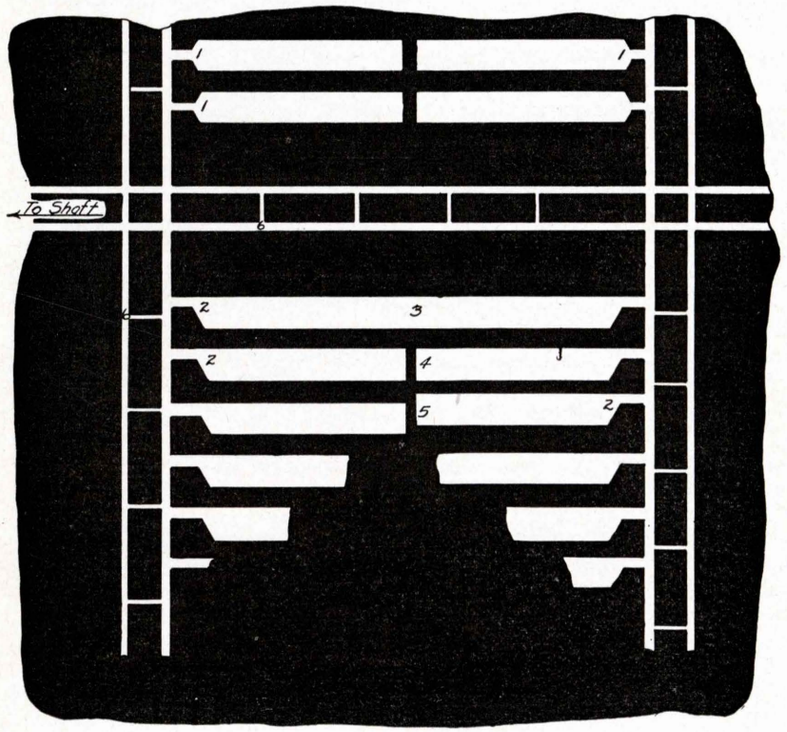

FIGURE 14. ROOM-AND-PILLAR SYSTEM OF MINING. This system of mining gets its name from the fact that the coal is removed from comparatively small rooms between rather large webs or pillars of coal which are left in place to support the roof. Main entries or passage ways are driven from the shaft toward the boundaries of the property. From these main entries cross entries are driven at right angles. The entries are always driven in pairs and every seventy-five or 100 feet an opening or "break-thru" (6) is made from one to the other. This is necessary in order to keep the air circulating thru the passages where the men are working. After these break-thrus have been passed and new ones have been opened up the old ones are stopped up so that the air will have to pass down the entry to the end before passing thru to the other entry and back to the shaft. Large fans are usually used to keep the air circulating thru the mine. Several methods of driving the rooms from the cross entries are used, two of which are indicated at (1) and (2). If these rooms are driven carefully they will meet as at (3) and may be "holed thru" to make one large room. A web of coal may be left between the ends of the two rooms as at (4) or if the rooms are not skillfully driven they may not meet properly as at (5). If coal is taken from the rooms only, as is usually done in Iowa mines, only 50 to 60% of the coal in the ground is removed. The pillars which are left soon crumble under the action of the air and crush down under the weight of the roof so that the coal left in a mine is soon practically worthless.

The roof must be supported, at least, long enuf to enable the miners to perform their work along the exposed face of the coal seam. After the coal has been removed from an area the roof over that area may be allowed to sink upon the floor, or "cave in." This will cause a settlement of the ground surface immediately above the excavated area. If the mine is located under open country this settlement is not objectionable, but obviously any mine under a city or built-up section cannot be permitted to let its roof settle.

Room-and-Pillar. The room-and-pillar system of mining gets its name from the fact that the coal is taken from comparatively small "rooms" between which are left rather large "pillars" of coal to support the roof. The system is popular for the reason that very little material need be taken into the mine from outside to support the roof. Very little "timbering" is required, since the size of the pillars may be varied in different localities so that they support the roof practically unaided.

In working a mine "room-and-pillar" main headings or passageways are driven in pairs thru the coal from the shaft toward the boundaries of the property. Cross headings or entries are opened off these main headings at right angles and at intervals equal to twice the depth to which rooms are to be driven, as illustrated in figures 14 and 15. The rooms are driven at right angles to these cross entries, or parallel to the main headings. (This is the general practice in the Iowa fields where the beds are fairly flat. This system is often considerably modified under other circumstances.) A room is usually started with a comparatively narrow entrance which is widened to full width just as soon as sufficient coal has been passed thru to safely support the roof over the cross entry at all times. If the rooms from adjacent entries are driven with skill and care they will meet and form one long room between the entries when completed as illustrated at 3 in figure 14. If the pillars between adjoining rooms are left standing and only the coal in the rooms taken out, as has usually been done in Iowa mines in the past, not over 67% and usually not over 55% or 60% of the coal in the ground is actually taken out. In the majority of cases the coal which is left in these pillars is soon crushed and slacked to such an extent that it can never be recovered.

Recently coal operators have been, when conditions would permit, adopting the plan of "drawing" or "robbing" the pillars as illustrated in figure 15. When this system of operating is carried out consistently, as high as 80% of the coal can be taken from the ground. It will be noticed that the pillars along the entries or passageways are left standing, even when those within the room areas are completely drawn. This accounts for the fact that about one-quarter of the coal is left in the ground when pillar-robbing is carried out.

In taking out the coal the miners make use of large amounts of powder or similar explosives. However, a great deal of hand work

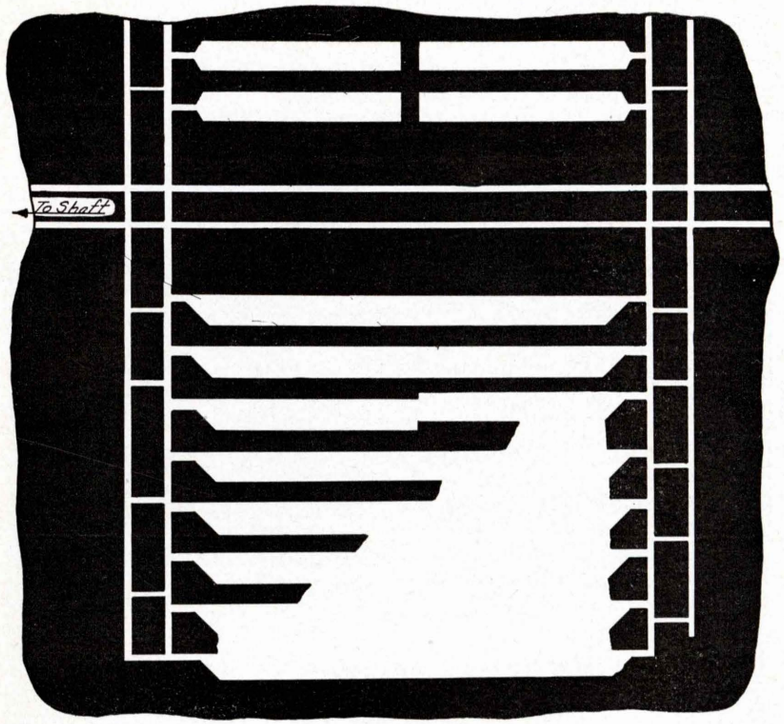

FIGURE 15. ROBBING PILLARS IN ROOM-AND-PILLAR MINING. When the rooms in the section of mine illustrated in figure 14 have all been worked out it is possible to draw or "rob" the pillars between the rooms and allow the roof to fall in as indicated here. In this way practically all the coal within a section is taken out. Sufficient undisturbed coal must be left along the entries to support the roof over them. This means that even when pillar robbing is carried out consistently about one-fourth of the coal is left in the ground forever. A great many Iowa mines now use this method.

must be done even then, in trimming up the face of the coal after a series of "shots" have been fired and in drilling the holes in which the explosives are placed for the next series of shots. In the early days of coal mining in Iowa each miner or group of miners worked independently of the others in the mine. Whenever a number of shots were prepared the miners fired them, regardless of what the other workers in the mine were doing. For this reason, general mine explosions caused by fine coal dust in the air, were usually more disastrous than at present. Now the shots are fired by specially selected "shot-firers" who inspect all shots to make sure that they are properly placed and prepared. The shots are fired in the evening after all the regular miners have left the mine and the shot-firers have specially constructed places of safety not entirely unlike the "bomb-proofs"

of the Western Front into which they retire while a series of shots is going off.

About the year 1900 several operators installed electric or compressed air mining machines in their mines. These machines undercut the coal along the exposed face, making it comparatively easy to

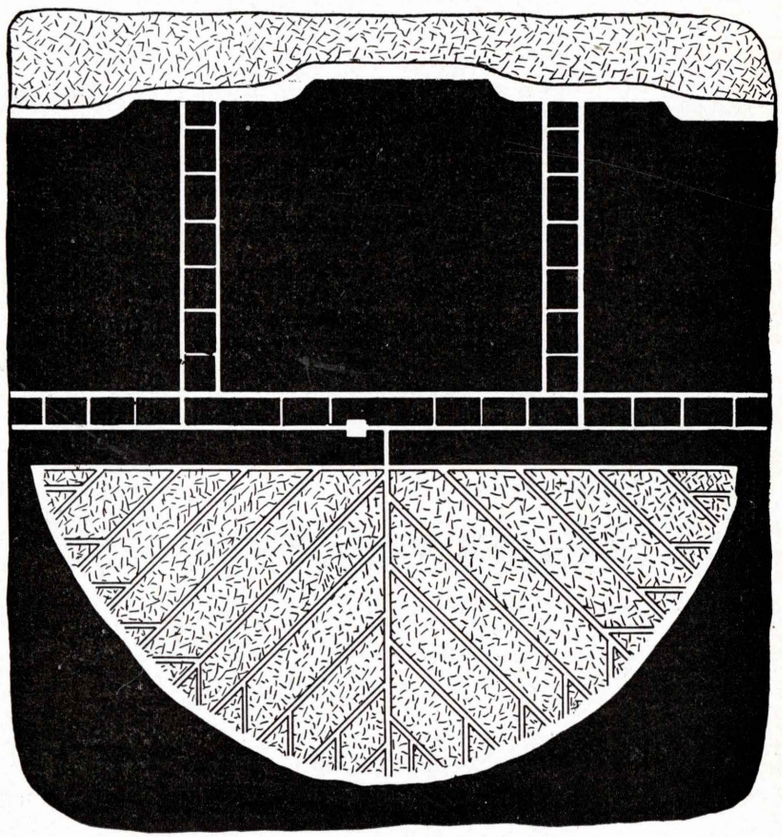

FIGURE 16. LONGWALL SYSTEM OF COAL MINING. In the upper part of the sketch is shown the system of mining which is known as longwall retreating. In this system cross entries are driven in pairs from the main entries out to the boundaries of the property. At the boundary a long straight or nearly straight face or breast is opened up, connecting these entries. This face is carried back toward the shaft or "worked home." All the waste material or "gob" is left in the excavated space and only enuf timbering is used to keep the passageway along the face safe. The roof is allowed to settle down on the mined areas. In the lower part of the sketch is shown longwall advancing. This system is just the reverse of longwall retreating. A straight or circular face is opened up as soon as the shaft is left and this is carried out toward the limits of the property. The gob is packed along the roadways to support the roof immediately over them. In this system the roadways must be maintained thru the mined out sections where the roof is allowed to settle. When longwall mining is used 90 to 95% of the coal in the ground can readily be taken out.

break the coal down with explosives or by the weight of the roof, as is done in longwall mining. In 1909, due to a disagreement between the operators and the miners as to wages to be paid men who worked with these machines, most of the machines in the state were taken out. In later years these machines have been returned and now many of the large mines in the state are using some form of mining machine in taking out the coal.

Longwall. Of late years the longwall system of mining has been gaining favor in Iowa coal fields. Authorities say that either "longwall advancing" or "retreating" can be used in the Iowa fields, tho as yet longwall advancing is practically the only method used. In the advancing method a long, continuous "face" or "breast" is carried forward as illustrated in figure 16. This face was carried as a straight line originally, but recently it has been worked as a segment of a circle. The coal is mined from this face, the waste material or "gob" is packed around the roadways and the roof is allowed to settle down on the excavated portions of the mine. As the roof settles the roadways or entries have to be deepened by excavating the floor or "brushing" the roof.

The settlement of the roof over the excavated portions in this system of mining is used to help the miners get the coal off the face. The coal is undercut for two or three feet all along the face either by hand or with undercutting machines. The temporary timbering, which is kept close up to the face, is then removed and in a few hours the weight of the overlying load causes the coal to break down. It is then loaded into the mine cars for transportation to the surface. In this system, practically no powder or explosive is used and 90% to 95% of the coal in the bed can be taken out. As coal becomes more valuable and the view that it is more or less a national resource, and not strictly personal property, becomes more generally accepted, longwall mining becomes more popular.

IOWA MINERS AND THEIR HOMES

"Half the world doesn't know how the other half lives." Iowa is a great agricultural state. The fame of her farms and their rich products has traveled far and wide. Iowans generally consider her a farming state and her citizens to be farmers. A large percent of Iowans living north of the Lincoln Highway have never seen a coal mine and know practically nothing of miners and their ways of living. Because miners live in isolated camps and labor underground, far from the light of day, they are often thot of as being quite unlike ordinary individuals, or forgotten altogether.

This is regrettable. Miners form no inconsiderable part of the population and citizenship of Iowa, as a trip thru Appanoose or Monroe county will soon convince anyone. Because they are a specialized class of workmen they seldom change occupations or leave the min-

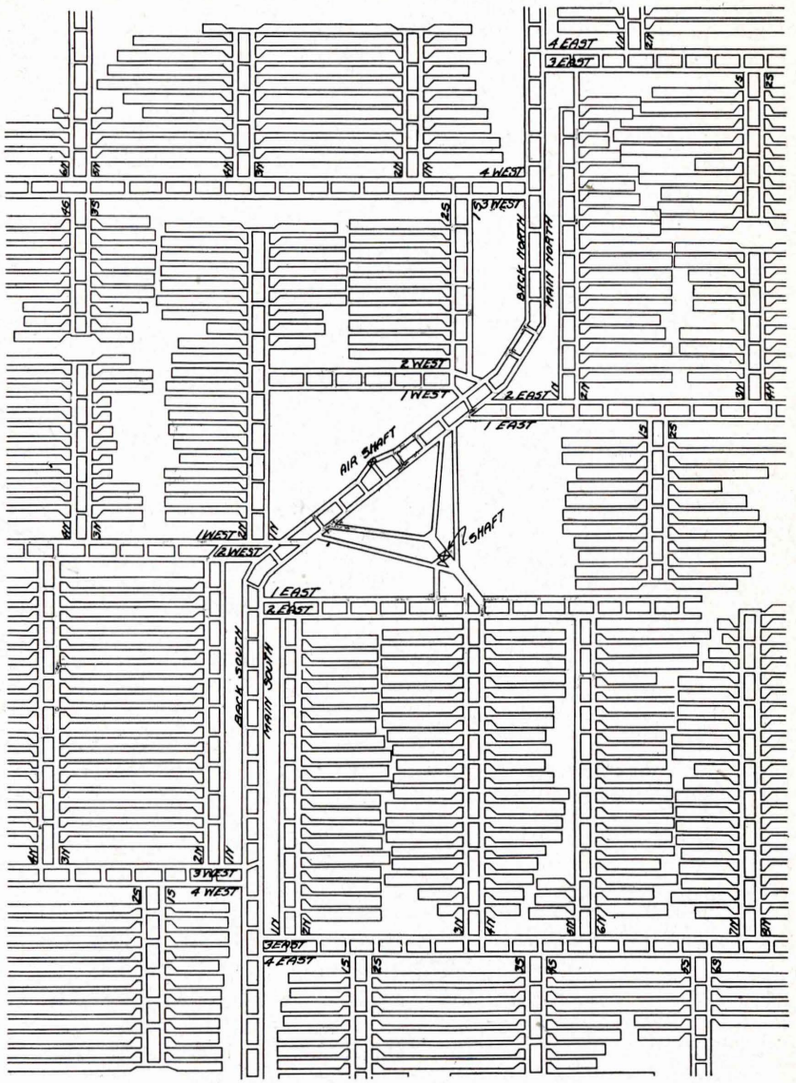

FIGURE 17. MAP OF AN IOWA ROOM-AND-PILLAR MINE. This sketch was made from the map of a large Iowa mine which is being worked on the room-and-pillar system. None of the pillars have been "robbed" or drawn, as yet. Only a small section of the mine is shown here. The points where coal is being taken out now are a mile or more from the shaft. The scale of the map as printed here is about 400 feet to the inch. Note the system of numbering the different entries.

ing camps. Hence they are little known outside their immediate neighborhoods.

Mr. R. T. Rys, State Mine Inspector for the Second Inspection District of Iowa, in his report of December 31, 1915, includes the following paragraphs on "Iowa Mining Camps:"

"Mining life is often misunderstood, and miners are regarded frequently by those not familiar with mining conditions as a class of vagabonds. Probably this unjust opinion would not have been formed were it more generally known that the roving life of a large majority

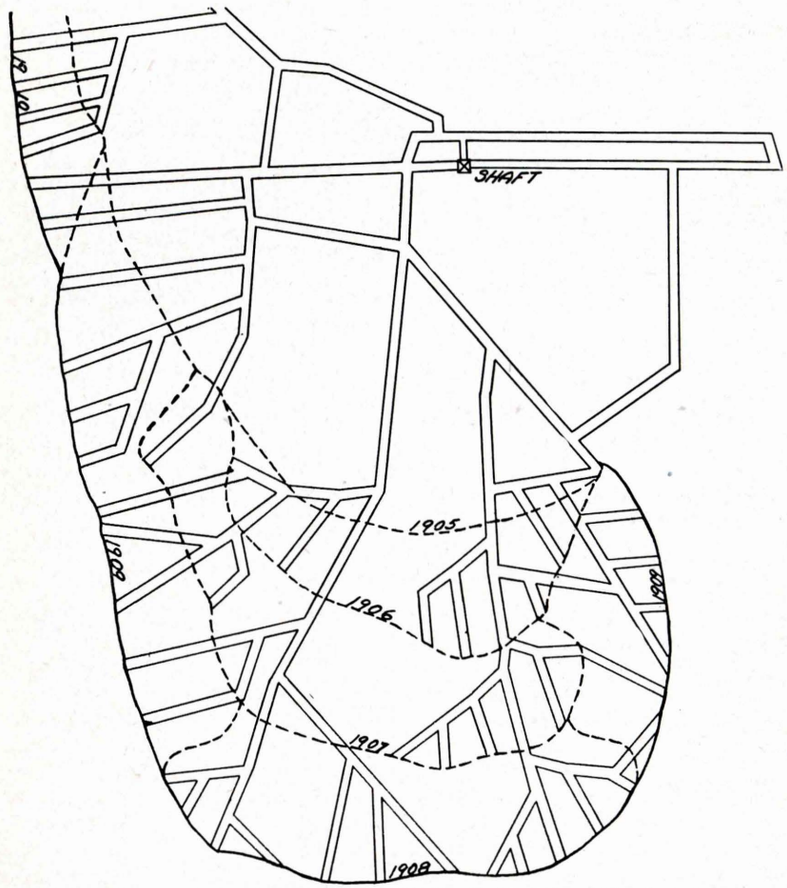

FIGURE 18. MAP OF AN IOWA LONGWALL MINE. This sketch was made from the map of a typical Iowa mine which is being worked on the longwall advancing plan. The dotted lines represent the position of the face of the coal at the end of each year's operations. The vein mined here runs three feet and under in thickness.

of the miners is not of choice, but is one forced upon them by the exigency of finding a new bread line. It is a great error to suppose that the mine workers and their families are taking delight in continually moving from one isolated coal camp to another. It is wrong to think that they have no desire for a permanent resting place, nor a longing for a home which they could call their own in some good locality where they could rear and educate their children into better and more capable men and women.

"The average life of a coal mine in the second inspection district of Iowa is probably less than eight years; consequently the existence of a mining camp in the "shooting" coal districts of our state is short, and makes it necessary for many mining men to forego the pleasure of a permanent dwelling place. After the mines in one locality are

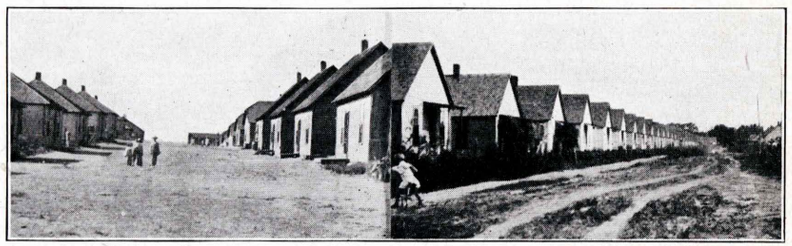

FIGURE 19. MAIN STREET OF AN IOWA MINING TOWN. These towns are usually called "mining camps." The term appears to be quite appropriate, as everything about such a town is very temporary; no shade trees, few sidewalks, makeshift buildings. Everything is in readiness for the day when the mines in that particular vicinity are worked out and closed and the miners move on to the next field. Often these "mining camps" exist for only five or six years and then are moved to the next mine or are deserted altogether.

FIGURE 20. A ROW OF IOWA MINERS' HOMES. The location of Iowa mining towns is seldom given much consideration. This vilage is situated on land which is completely flooded during a wet spring or a sudden great rainfall. Obviously these houses can have no storage cellars or basements. The fact that the dwellings are all alike and evenly spaced on an absolutely straight line down the street is evidence that they were built by the coal company and rented to the miners.

worked out and abandoned, the mine workers and their families are obliged to move to some other camp to live and labor. Their habitations are no ancient family mansions where their ancestors were born and lived for generations past, but are so transient in their existence that if they were to cherish a desire to see the house where they were born, many of them could find it not. The house and the camp have been torn down, and scattered here and there, and in many instances the farmer's plow has furrowed the ground, and corn grows where they once stood. The rich mines of Happy Hollow, Kirkville, Excelsior, Carbonado, What Cheer, Muchakinock, Knoxville Junction Pekay, Lost Creek, Keb, and many others that could be named are all abandoned and their once flourishing camps are no more. There remain at present only the old "Dirt Dumps" standing as monuments to mark the place where they used to be. Evidently this brief dura-

tion of the mines has not been conducive to the erection of substantial and attractive camps. The majority of their houses are built in such manner, and of such material and workmanship as to leave their occupants no alternative but to live very close to nature. The advice of an efficient architect was not sought in their planning, nor that of a landscape artist in their layout. They have no beauty to look upon nor charm to dispel their gloomy aspect. Some of them have been pitched in lonesome and unattractive places, and are far from railroad stations and established towns. It is difficult and expensive to go to them and to get out of them.

"It is not claimed that Iowa coal camps are worse, nor probably as bad as some mining camps in other states, and it must be admitted that the camps built of late years are better than the ones built in the early period of mining in our state."

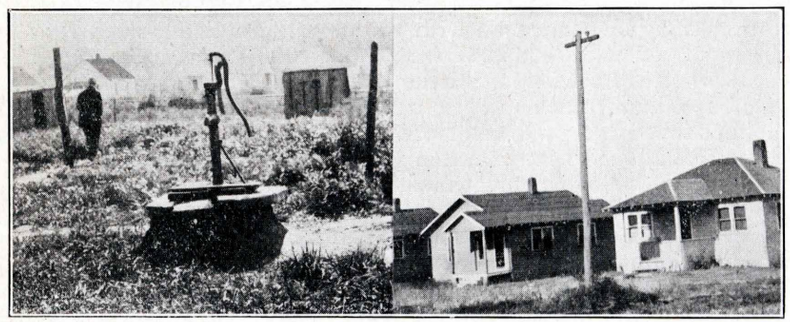

FIGURE 21. THE "TOWN PUMP," IN AN IOWA COAL CAMP. A well is usually provided for every ten to twenty houses. These wells are often placed in the middle of the street, as the most convenient location for all users.

FIGURE 22. UP-TO-DATE MINERS' HOMES. Showing what is being done in many of the newer mining towns of the state. These houses are located, on high ground, are stuccoed, have plenty of windows, good porches and electric lights.

An engineer who made an investigation of conditions in Iowa coal mining camps during the summer of 1919 has this to say of the miners:

"The miners, generally, are dissatisfied with the conditions under which they have to live, and particularly as it concerns their families. They are earning fairly good money in spite of the large amount of idle time; they dress well; they have all they want to eat; many of them own automobiles; and yet the conditions under which they have to live in order that they may do the only kind of work they know how to do, do not meet their demands.

"When asked why they did not quit the mining camps and engage in other lines of work in localities where their living conditions would be more to their liking, the miners' replies were practically always to the effect that they had been raised in the mines and did not know how to do anything else. However, they are very insistent that they want their boys to have such advantages, from the standpoint of edu-

cation and opportunity, that mining will not be a necessary occupation, but they are at a loss to know how to accomplish the ends sought.

"It is claimed that practically all of the younger men who went into service from the mines will not return, they having found themselves sufficiently adaptable to engage in other lines of work.

"Life in many of the camps is dreary. It is very difficult, except by automobile, to get to town, and there are no attractions or entertainments of any sort for the pleasure of the miners or their families. This in itself would prove too much of a hardship for most people."

IMPORTANCE OF IOWA COAL INDUSTRY

The coal fields of Iowa underlie approximately 20,000 square miles. (See figure 1.) Fully one-half of this area may be considered as underlain with workable coal seams, much of it by several beds, so that it is safe to say that there are not less than 10,000 square miles, or nearly one-fifth of the entire area of the state, in which mining operations may be carried on with profit. In our enthusiasm for the state as a producer of foodstuffs we overlook the fact that Iowa enjoys the possession of coal fields which many European nations would consider of first importance to their national prosperity. We lose sight of the fact that Iowa produces more coal than each of thirty-six states of the Union, that a considerable portion of her population is supported directly by employment in the coal-producing industry.

It has been calculated that one pound of coal possesses as much energy as is developed by an average man in working one day. Therefore about 300 pounds will represent the labor of one man for a year. On this basis the 15,464 miners working in Iowa in 1917 produced an amount of energy equivalent to 60,332,040 men laboring every working day for a year. Most of this coal is used within the borders of the state, so the miners of Iowa in that year accomplished nearly as much as tho 50,000,000 men had been working at the task of hauling Iowa's freight, grinding her grain, burning her brick and cement, and generating light and making heat for her homes. The 9,049,806 tons mined that year would fill 226,245 standard (forty-ton) freight cars. It would take 4,525 fifty-car trains to haul these cars away from the mines. These trains standing end to end would form five lines across the state from east to west or would stretch in one continuous line from New York to Denver, with several trains left over.