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Development and operation of the Universal Coal Mine, Clinton, Indiana

Horace Herbert Clark

DEVELOPMENT AND OPERATION

of the

UNIVERSAL COAL MINE

CLINTON, INDIANA

by

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IMPORTANCE OF COAL

COAL is the most important natural mineral resource in the United States. The known reserves are estimated at five thousand years, based on present consumption. Civilization has made its greatest progress since the discovery of coal. The art of metallurgy owes its development and very existance to coal. The lives and comfort of the people depend on it, not alone for its fuel value, but on account of the many valuable by-products derived from it such as medicines, dyes, tars, oils, liquid fuels, coke and gas.

ECONOMICS OF THE COAL INDUSTRY

The economics of the coal industry are very interesting. The following table shows the main sources of energy in the United States, how the various kinds used were proportioned in the last three years, and how the proportions have changed when compared with the period 1923 to 1929.

Energy Used in United States	Last 3 years	1923 to 1929	Per cent Change
Coal	45%	60%	25% Decrease
Oil	23	18	28 Increase
Natural Gas	7	5	40 Increase
Water Power	9	6	50 Increase
All Other	16	11	45 Increase

This large increase in the use of water power and natural gas, and the decrease in the use of coal, is one of the reasons for our present unemployment problem, and attendant "Hard Times". Coal requires considerable labor in its production, distribution and utilization, while the other sources of energy require very little labor.

Now let us consider these various sources of energy and their estimated known reserves.

	Ultimate Known Reserves	Annual Present Use	Life at Present Rate of Use
Natural Gas	40 Trillion Cu.Ft.	2 Trillion Cu.Ft.	20 Years
Oil	13 Billion Barrels	1 Billion Barrels	13 Years
Water Power	38 Million H.P.	12 Million H.P.	
Coal	2500 Billion Tons	500 Million Tons	5000 Years

WATER POWER NOT IMPORTANT

The above figures are very significant. The total potential water power is but three times the present installed capacity, which now supplies only 9% of our energy. Therefor the total water power in this entire country can supply only 27% of our present energy requirements. With this fact in mind,

and believing that the life of Oil is but 13 years and of natural gas but 20 years, we are convinced that COAL is sure to return to its former position as the "KING of Fuels". The enormous coal reserves of the United States is the largest single factor in the future of this country. Approximately three-fifths of the world's known coal reserves are located in the United States. Approximately four-fifths of the world's supply is located in the United States and Canada combined.

During the period from 1895 to 1918, production was the keynote in the coal industry. The close of the period of rapidly expanding markets in 1918 and 1919 found the coal industry prepared for an ever increasing demand. The depression of 1921 was the beginning of a slow decline which became increasingly manifest in the intervening period from 1922 to 1929. During the severe depression from 1929 to 1934, the necessity for a study of markets and distribution problems has come home to the industry.

The salvation of the coal industry lies in its having become distribution-minded. Distribution-mindedness gives rise to creative merchandising. And the extension of creative

merchandising with its relatives of product research, market analysis, breakdown of sales costs, lowering of sales resistance by the determination of geographical supremacy areas, effective and intelligently selected and directed promotion, form perhaps the strongest counter force that the coal industry can set against narrowing margins of profit and decreasing volume of business.

COMPETITIVE FUELS GAIN

A diagnosis of the factors which stimulated the rising use of substitute fuels and the increasing economy of coal consumption, is exceedingly difficult and complex, but no doubt the price factor has been an important contributor. In the pre-war period with the spot price of coal averaging $1.20 at the mine, the production of bituminous coal had consistently doubled each decade. This had become an accepted performance upon which coal company expansion and financing programs were predicated. It was inconceivable to the coal man that there could be any break in this long established precedent. Then came an era of high prices resulting from the disturbances of the World War. Coal prices at the mine rose from an average of $1.20 per ton during the pre-war to $2.60 per ton in 1916. This extraordinary doubling in the price of coal almost overnight,

stands without precident in the century old history of the coal industry. There can be little question that this acted as a powerful incentive toward economizing in the use of coal, and encouraged competitive fuels such as oil and gas to seek a larger share of the fuel market.

GEOLOGICAL DISTRIBUTION OF COAL

Geologic Age	Characteristic Coal	Where Found
Quarternary	Peat	Wide Spread
Tertiary	Lignite and Brown Coal	Vermont, Texas, Calif. other Western States
Cretaceous	Bituminous	Col.New Mex.Wyo.No.Dak. S.Dak.Mont.Wash.Ore.
Jurassic	Bituminous	Little in few places
Triassic	Bituminous	Va. and No.Carolina
Carboniferous	Bituminous and Anthracite	Eastern States. East of Mississippi.
Devonian	(Trace of coal in few places)	
Silurian	( )	
Ordovician	( )	
Cambrian	( )	

The Carboniferous may be further divided into:

1. Permian
   Limestone, sandstone, shale.

2. Carboniferous or Pennsylvanian Series
   Shale, sandstone, limestone, COAL, iron ore.

3. Lower or Eo-Carboniferous or Mississippi Series
   Limestone, sandstone, shale.

Coal in Indiana is restricted to the middle division (2). As the lower part of the Middle Division is usually very thick sandstone, often gritty, or even approaching a conglomerate, the middle division is further divided into

Coal Measures (a)

Millstone Grit (b)

Commercial workable coal in Indiana is restricted to the Coal Measures (a) of the Carboniferous Rocks (2).

INDIANA COAL RESOURCES

Indiana is especially fortunate in having large coal reserves estimated at 500,000,000 tons of workable coal in an area of 250 square miles. Coal was first discovered in Indiana over one hundred years ago. It outcrops in many places, and is known to exist at depths of one thousand feet. Indiana coal fields are a part of the "Eastern Interior Field". This field is an oval, elongated basin extending northeast and southwest, with the marginal beds dipping gently toward the lowest portion, which lies

in Illinois. It covers most of Illinois, southwestern Indiana, and a small part of Western Kentucky, an area of 47,000 square miles.

GEOLOGY OF INDIANA COAL

The coal-bearing rocks rest unconformably on lower Carboniferous, Devonian and Silurian strata, the basal member being a sandstone, probably the Potsdam. The coal-bearing rocks, which have a maximum thickness of 2200 feet in Illinois, belong to the Coal Measures, although the upper part may be of Permian age, and the highest workable coal beds are classed as Freeport or Conemaugh. The coal seams occur in the lower portion of the section, and hence outcrop around the margin. Mining operations have been confined to a narrow belt, because near the center of the basin the coal beds underlie too great a thickness of unproductive strata to permit of profitable working under present conditions.

Great difficulty has been encountered in attempting to correlate the coal beds of different parts of the Field, because of the varying sections shown from place to place, and lack of continuity of the beds. Consequently, the custom has arisen of giving the coal beds numbers instead of names.

The coals of the Eastern Interior Field although varying widely in quality, are all bituminous. The Indiana section is subdivided as follows:

Permian-Merom group: Upper or barren Measures, 0'-400'.

Coal Measures (Wabash group;
(Main coal bearing measures, 100'-600'.
(Mansfield group:
(Basal sandstone member, 0'-200'.

The Indiana section shows at least 25 distinct coal beds, nearly all of them 2 feet or more thick in some places, and nine of them continuing of minable thickness over large areas. The upper five of the nine numbered ones are coking and occur in broad sheets, while the lower four occur in basins and are not extensively workable. No.5 is the most important bed in the State and can be correlated the entire length of the field.

CLINTON DISTRICT COAL FIELDS

Vermillion County is located on the Northeast edge of the Indiana section of the Eastern Interior Field, in what is called the Clinton District. The Universal Coal Mine is located in the Southwest part of Vermillion County, approximately Township 14 North and Range 10 West. The main topographic feature of this area is the valley of Brouillet's Creek which with rather broad bottom, ½ to 1 mile wide, is cut down sharply from the general level of the upland from 60 to 100 feet. Another feature is a rather remarkable

interruption of this level bottom land in the shape of a knoll nearly a quarter of a mile long with a height of about 40 feet. Indian mounds occur at each end. Coal Creek and Gin Creek are the proncipal tributaries, and as they and the other tributaries cut down nearly to the level of the main creek, it gives the upland near Brouillet's creek a somewhat broken appearance.

The outcrops of this area are coal VII. It is a solid bed 4'4" thick with a roof of bone coal or black bituminous shale, and a bed of limestone underlying fire clay. It contains less sulphur than coals around Clinton. The roof is good, the floor incline to "creep". It is characterized by clay veins. The coal tends to have a parting 6" to 8" from the bottom running from ¼" to a line of considerable boulders. The bed is practically level with only a slight dip to the south and west.

STRATIGRAPHY AT UNIVERSAL MINE

The shaft of the Universal mine is located in the valley of Brouillet's Creek, where the ground level is below the outcrops of coal VII, hence none of this coal is found in the workings. Coal VI is only one foot thick in the shaft. The first workable coal to be found is coal V, known as the fifth vein. It is found at a depth of 150 feet and averages 5 feet in

thickness. The roof of this seam is shale and the floor is clay 3 feet thick on a bed of limestone. The seam is practically level with a slight dip to the south and west. About 100 feet below coal V is coal IV, commercially known as fourth vein. This seam has a roof of shale and a 3 foot floor of clay on a bed of sandstone. It is nearly level with slight dip to the south and west. About 65 feet below coal IV is found coal III. It is a 6 foot bed with a roof of shale and a floor of clay over shale. It is not worked at present, but it and the other two seams are known to underlie the entire property, having been tested by numerous drill holes, both by the core drill and churn drill. The Minshall seam is thought to lie about 100 feet below coal III, but drilling here was not carried on below the third vein coal.

INDIANA DEVELOPS COAL DEPOSITS

In 1886 natural gas was discovered in Indiana, and this soon changed the State from a nearly purely agricultural one, into a manufacturing state of great importance. Ten years later, however, signs were evident that the gas fields were becoming exhausted. The coal deposits of the State then received special attention, so that one may say that the real development of the Indiana Coal Deposits began about 1898. The great anthracite strike of 1902 gave Indiana coal operators an

opportunity to expand their market. Natural gas reserves continued to decline, with the result that high prices for Indiana coal and large demand produced good times in the Indiana Coal Fields and the years 1903, 1904 and 1905 saw capital seeking investment in Indiana Coal Companies and a further effort made to expand mining and marketing operations. This intense development soon led to overproduction, with the result that there was a general slumping of prices and prosperity. Low prices eliminated many of the less profitable mines. By 1908 conditions in the Indiana coal industry were more stable, but prosperity had not returned.

DEVELOPMENT OF UNIVERSAL COAL MINE

Being one of Indiana's largest manufacturers, and with the foregoing information available, the United States Steel Corporation, through its subsidiary the United States Fuel Corporation of Pittsburgh, Pennsylvania, began looking over the Indiana Coal Fields as a possible source of supply for the steel mills at Gary, Indiana. Engineers were sent out from Pittsburgh to make an investigation of the various Indiana fields with respect to their suitability for steel making. Coal was shipped from various producers to the mills at Gary and tested, with the result that Indiana Fourth Vein coal was considered suitable for steel making, as it was found to lower in ash and sulphur than other Indiana coals.

SELECTING THE ACREAGE

As a result of their investigation and tests, the corporation took options on several square miles of land in Southwestern Vermillion County, and just across the county line in Northwestern Vigo County, in the so-called Clinton District, as this district was nearest to Gary of any that measured up to the high quality of coal required for steel making. About thirty drillings were made over the sections, some by churn drill and others by core drill, as a result of which the Corporation purchased 2800 acres or more than four square miles of the land, and proceeded to open up a mine, with an estimated reserve of 14 million tons.

BUILDING THE TOWN AND SURFACE PLANT

A townsite was selected on the higher ground adjacent to the location chosen for the mine shaft. This townsite was called Universal. It is located about three miles west and two miles south of Clinton, Indiana, the County Seat of Vermillion County, and about four miles east of the Indiana-Illinois State line and about one mile north of the Vermillion-Vigo County Line.

One hundred and fifty houses were erected for the miners and other employees of the Corporation. A commissary was established, and a general store. The nearest railroad was at

Clinton five miles to the north-east, and great difficulty was encountered in transporting the machinery and materials to the mine site. By the time the shaft was completed, the railroad had built a branch line from Clinton to the mine site, so that work of erecting tipple, boiler and power plant, car and repair shops, stable, supply house, fan etc., was carried on under favorable conditions after that. All this investigating, drilling and construction work took about two years, so it was 1910 when the first coal was shipped from the Universal Mine.

SINKING THE SHAFT

The shaft site was selected at approximately the center of the acreage on a limestone bed in the lowland of the valley of Brouillet's Creek, about twenty feet above drainage. The shaft is a rectangular double compartment type with a third chamber divided into two compartments, one for air and one for a man-way. The log of the shaft is quite similar to the log of the nearest drill hole; although quick-sand was encountered in the shaft just below the limestone bed. The complete log of the shaft is as follows:

LOG OF SHAFT

Limestone	10 feet	
Sandstone	20	
Sandy Shale	48	
Shale	47	
Coal "VI"	1	
Clay	4	
Shale	15	
Bone coal	2	
Shale	3	
Coal "V"	5	155 feet
Clay	3	
Limestone	4	
Shale	10	
Sandstone	15	
Shale	35	
Coal	1	
Clay	5	
Shale	12	
Sandstone	10	
Shale	5	
Coal "IV"	5	105-260 feet
Clay	3	
Sandstone	-	

DRIVING OF ENTRIES

At the bottom of the shaft, main entries lead in four directions, east, west, north and south. These are all double entries, the larger one for haulage being ten feet wide, with a pillar of coal eighteen feet wide between them. Break throughs, six feet wide are made in these pillars every fifty feet for safety and ventilation.

Cross entries, also of the double entry system are driven every four hundred feet, to the right and left of the main entries.

Rooms are turned off to the right and left of these cross entries every forty feet. It is in these rooms where actual productive mining takes place. When Universal Mine was first opened, pick and shovel and hand drilling was used, with mule haulage. Later the mine was mechanized, to reduce costs, which had increased considerably due to miners organizations and higher wages. Electric drills, electric cutting machines and electric loaders were installed for mining the coal, and electric locomotives were used for haulage.

MINING AND BLASTING

Chain machines are used for undercutting the coal. The machine consists of a low metal bed frame upon which is mounted a motor that rotates a chain to which suitable cutting teeth are attached. The average height of the cut is 4½ to 5", being about 6" thick at the face and 4" thick at the back. The depth of the cut is about 5', or the thickness of the seam. Each cut is about 42" wide. Six cuts are made across a twenty foot room. In rooms and entries not over 20' wide, three shots fired simultaneously are sufficient to bring down the coal. Shots are placed about 5 feet back from the face and equally spaced across the cut, slightly above the center. Electric drills are used to drill the holes for blasting.

VENTILATION

The minimum quantity of air required per man per minute is 100 cubic feet. That means for a crew of 300 men the fan must be able to deliver 30,000 cubic feet of air per minute to the workings.

LOADING

Electric loading machines are used for scooping up the coal after the shots and loading it into cars. The loader consists of an electric motor mounted on a steel frame operating a pair of revolving scoops, which throw the coal on a conveyor which elevates it into the cars.

HAULAGE

Electric storage battery locomotives gather the cars from the rooms and deliver them to the cross entries, where trolley motors haul them to the shaft. Each car has a capacity of 2 tons of coal.

HOISTING

The hoist is steam operated, and is the double cage type, the loaded car ascending while the empty car descends. A belt conveyor carries the coal from the shaft to the tipple where the coal is hand picked for slate, or other impurities.

PREPARATION

At the top of the tipple the coal is dumped on shaker screens where the sizes are graded to suit the market demand.

Sizes Made

6" Lump
4" Lump
3" Lump
2" Lump
1¼"Lump
6x3"Egg
6x2"Egg
6x1¼Egg
3x2" Nut
3x1¼ Nut
Mine Run (60% is 2" and over: 40% is under 2")
2" Screenings
1¼ Screenings
2" Modified screenings
1¼ Modified screenings
2" Dedusted screenings
1¼"Dedusted screenings
¼" Carbon or Duff

To meet the demands of the domestic stoker trade, a shaker screen is placed at the chute for loading 2" screenings where all fines below ¼" are removed. The "fines" or "duff" or "carbon", as it is sometimes called is sold to cement mills or Electric power plants for use as powdered fuel.

Typical analysis of Mine Run.

	Percent as Rec'd in Lab.	Percent Dry Basis
Moisture	9.43	
Ash	6.72	7.42
Volatile	35.87	39.60
Fixed Carbon	47.98	52.98
	100.00	100.00
Sulphur	.83	.91
B.T.U.	12,163	13,429
Ash Fusion	2400 Deg Fahr.	

POWER PLANT

The power plant consists of Water tube boilers and chain grate furnaces. Steam is furnished to three 200 Kilowatt direct connected direct current generators operating at 250 volts. The ventilating fan is also steam driven, as is the hoist and all surface pumps. All underground machinery is electrically operated from the 250 volt DC circuits, using copper trolley and bonded rail return.

Recently electric power connections were made with a local public utility company which operate a 33,000 volt loop circuit in the vicinity. A transformer sub station is located on the coal company's property transforming from 33,000 volts to 2300 volts. Rotary converters operated by 2300 volt synchronous motors convert the alternating current into direct current at 250 volts.

CAPACITY OF MINE

The output of the mine is 20 cars of 50 tons average or 1,000 tons per day of one 7 hour shift. This is the capacity of the underground machinery. Capacity could be doubled by putting on another shift. Not more than two shifts per 24 hours could be worked however, due to time required for clean-up, blasting, etc.

RAILROAD CONNECTIONS

The Chicago & Eastern Illinois Railroad has a stub line into the property with five side tracks under and adjacent to the tipple. Total track room is enough for 100 cars, but railroad restrictions limit the number of loaded cars standing on track at any one time to 200% of the daily capacity, which is 200% of 20 cars, or a total of 40 cars.

SAFETY AND FIRST AID

Safety and first aid are of utmost value in a mine, and stringent laws compel operators to protect their men at all times. Many operators realizing the importance of safe operations, have many additional safety features, not required by law, but nevertheless beneficial to the men. In a mining district where the union scale of wages is paid, and all mines operate under union contract, the mine that offers the best and safest working conditions attracts the best men.

OPERATING COSTS

Based on 1,000 tons per day	Dollars Per Day	Cents Per Ton
Administration and profit	$200.	$.20
Taxes	20.	.02
Fire Insurance	40.	.04
Depreciation	100.	.10
Rentals	20.	.02
Top Labor	300.	.30
Power Purchased	100.	.10
Dues and Assesments	10.	.01
Compensation Insurance	50.	.05
Royalty	100.	.10
Supplies	100.	.10
Bottom Labor	690.	.69
Safety and Welfare	10.	.01
Total	$1740.	$1.74

SELLING EXPENSE

Coal offered on the open market is sold through a sales agent. Selling Expense is 8% of market price, which varies from $1.00 per ton for carbon to $2.50 a ton for 6" Lump. The market price varies with supply and demand. The poor quality coals of other shippers have a ready market at lower prices, as few coal buyers recognize the wide difference in performance of various coals. Figured in net results, the cheapest coal per ton is the most expensive per thousand pounds of steam.

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