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Methods of mining and the preparation of coal in the Belleville, Illinois District

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METHODS OF MINING AND THE PREPARATION OF COAL
IN THE BELLEVILLE, ILLINOIS, DISTRICT.

by

Harry William Shaw

A

THE S I S

submitted to the faculty of the

SCHOOL OF MINES AND METALLURGY
OF THE
UNIVERSITY OF MISSOURI

in partial fulfillment of the work required for the

DEGREE OF

BACHELOR OF SCIENCE IN MINE ENGINEERING.

Rolla, Mo.

1913

Approved by

C. R. Forbes

Professor of Mining.

15687

MSM
HISTORICAL
COLLECTION

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The methods of mining and the preparation of coal for the market in the Belleville District represent the most modern and up-to-date methods in the state of Illinois. Mine No. 17 of the Consolidated Coal Company is the largest in the district and the methods used here are typical of the entire district.

MINERS.

The class of miners employed is of the highest type. Most of them live in Collinsville and are conveyed to and from the mine by the company in coaches fitted for that purpose. Most of the miners own their own homes and are steady workmen. There are few men here of the roaming class so frequently found in mining districts.

LOCATION.

The mine is located about three and one-half miles southwest of the city of Collinsville, on a spur of the Vandalia Railroad.

COLLINSVILLE.

Collinsville is a thriving city of some 15,000 inhabitants; owns its own electric light plant and water-works, and has paved streets and substantial buildings. They have hourly interurban service to St. Louis. On account of its many advantages as a workman's town labor is plentiful.

POLICY OF COAL COMPANY.

The policy of the coal company is safety first and this is well borne out by the fact that only one fatal

accident has occurred since this mine began active operations in 1904.

CAPACITY.

The mine employs about 400 men and has a daily capacity of from 3200 to 3500 tons per eight hour shift. The mine is operated with one shift only. The company has tried several times to place it on a two shift basis but the miners are very much adverse to this plan and up to the present time the plan has been unsuccessful.

ACREAGE.

Two thousand acres of coal land are tributary to this mine and the amount mined is about 6,000 tons per acre. The average number of days worked per year is about 250.

TIPPLE.

This is of wooden construction and is of the four post type. Yellow pine lumber is used throughout. The main members are made up of two 6" x 12" timbers bolted together with 5/8" bolts, bracing being made of 6" x 12" material. The shaking screens are carried on an independent structure just inside the main tippæ bents. This arrangement entirely eliminates vibration to the main tower and adds considerable to the stability of the general construction. The entire structure is covered with No. 22 galvanized iron.

FAN.

Air for ventilating purposes is supplied by a 5' x 16' double inlet centrifugal fan which is ordinarily run as a blower. It is direct connected to a 12" x 24" Norwalk engine. This fan is run at 95 R. P. M. and delivers approximately 1000 cubic feet of air per revolution under a water gauge of 3/4". The fan is not situated directly above the downcast shaft but is placed about thirty feet to one side, the air being conducted to the shaft by means of a concrete tunnel which is provided with explosion doors, placed directly over the downcast shaft. A system of doors is provided by which the air current going into the mine may be reversed in case such action becomes necessary.

VENTILATION.

The air current is divided into three splits at the bottom of the downcast shaft and conducted to the working face by means of secondary splits. In the main entries which are driven triple the two outside entries are used for the intake and the middle one for the return. The volume of air entering the mine is more than ample to supply 100 cubic feet per man and 500 cubic feet per mule, as provided by the Illinois mining laws. Not more than 100 men are employed on each air split and rooms are never turned ahead of the last open cross-cut.

Both over-casts and under-casts are being used at this mine, depending on conditions. The mine is very dry and there is no tendency for the under-cast to become a reservoir for the accumulation of water, thereby cutting off the air supply. These air bridges are always placed in the return air course and are made either of brick masonry or concrete.

Stoppings between intake and return air courses are made of the waste rock and slate and packed securely with fireclay to prevent the leakage of air.

AIR-SHAFT.

The air-shaft is 8'10" x 15'6" in the clear and is fitted with a stair-way by which the men can escape in case the hoisting shaft is inaccessible. Air pipes, steam lines, electric wires, etc., are also placed in this shaft.

MAIN SHAFT.

The main shaft is of the same size as the air-shaft and is used as the upcast. It is cribbed its entire depth with 3" x 10" creosoted oak lumber.

SCREENS, WEIGH-BOX, ETC.

Self dumping cages are used and are arranged for cars having a capacity of 2-1/2 tons of coal. The coal is dumped automatically from these cages into a receiving chute which delivers the coal to the weigh-box which holds the contents of two cars, i. e., five tons, thus permitting continuous hoisting while the railroad cars are being shifted under the tippie. The weigh-box is equipped with a five-ton

tipple scale with a quick reading dial which automatically registers the weight of each car. The coal is discharged from the weigh-box upon the shaking screens through a door which is operated by means of a steam jack, located in the weighman's house. The jack has a valve action which allows the coal to be discharged gradually from the hopper upon the shaking screens.

There are two of these screens, placed tandem, carried on rollers and driven by eccentrics. The screens are inclined one inch in four and are six feet wide.

The upper screen has 13 linear feet of three inch round perforations, and the lower 11 feet of six inch round perforations. The slack and nut passing through the upper shaking screen is delivered directly into a car on the slack track or into a bin which feeds the drag conveyor to the washery. The coal passing through the lower shaking screen is delivered into the egg coal car below. The coal passing both the shaking screens is delivered into a car on the lump track. If it is desired to ship run-of-mine coal the screens can be covered with plates and such coal can then be delivered into a car on the outside track. The screens are designed to shake from 90 to 100 times per minute and are driven by a 12" x 20" Norwalk engine, located directly below the tipple.

ELECTRIC EQUIPMENT.

This consists of one 150 K.W. direct current generator which furnished power at 250 volts. It is direct connected to an 18" x 19" Ideal high speed engine.

Two 10-ton G. E. motors are used in the mine, one on the North side and one on the South. Rails are bonded and used as the return. The mines is equipped with telephones throughout.

STEAM PLANT.

Power for the hoist, fan, machine shop, compressors, generator, etc., is supplied by a battery of nine 72" x 18' fire tube boilers, representing a total of 1350 horsepower.

HOIST.

In order to handle the large tonnage of this mine, i.e., 3,200 to 3,500 tons of coal per eight hours and to handle the unusually large pit cars, a Litchfield hoist of the largest size has been installed. The hoist is a 24" x 36" duplex first motion hoist. It has a capacity of 4,000 tons per eight hours. The winding drum is 8 feet in diameter and grooved for 1-1/4" rope.

COMPRESSED AIR PLANT.

Compressed air furnishing power for the 32 machines used to undercut the coal is supplied by three compressors, two Norwalk and one Sullivan. They are all of the straight line type and compress the air in two stages up to 100 lbs. The large Norwalk has a 28" simple steam

cylinder, the low pressure air cylinder being 30" and the high pressure air cylinder being 19" with a common stroke of 30". The small Norwalk has a 20" simple steam cylinder, the low and high pressure air cylinders being 30" and 20" respectively, with a 24" stroke. The Sullivan compressor has a 24" simple steam cylinder, the high pressure air cylinder being 16-1/2" and the low pressure being 26", with a common stroke of 30". These compressors have a combined capacity of 5,000 cubic feet of free air per minute. The air discharge pipe from the compressors is 6" in diameter and meet in a common pipe 8" in diameter leading to the receiver. Gate valves between the compressors and receivers permit the cutting out of any compressor if it is desired. The receiver is fitted with a drain cock at the lower end, permitting the discharge of condensed moisture. The main pipe leading from the receiver to the bottom of the shaft is 10" in diameter. At the bottom of the shaft the air line is divided into two 6" lines running into receivers on either side of the shaft, thus avoiding all fluctuations in pressure at the machines and effectively removing entrained water. A 6" pipe leads from each receiver and extends along the main entries. The cross entry pipes are 3" in diameter and the room pipes supplying the machines are 1-1/2" in diameter. The pressure at the machines is 80 lbs.

CHARACTER OF DEPOSIT.

The coal bed, geologically known as the No. 6 seam, of high grade Illinois coal, varying at this mine from 6 to 7 feet in thickness, is reached by two double compartment shafts 8'10" x 15'6" in the clear and 232 feet deep, one for hoisting and the other for ventilating purposes. Props are used but little, the estimated amount of timber being about 10 feet for every 100 tons of coal mined. The mine is dry, no water being encountered except in the shaft. In addition to its other advantages the mine is non-gaseous.

The floor is of fireclay and the coal is overlaid with a thick stratum of limestone, with a draw slate at times intervening. This slate varies from a few inches to three feet. The coal seam is practically level, having only a slight dip to the northeast.

METHODS OF MINING.

Until about two years ago the mine was worked by the room-and-pillar plan. It is now being worked by the panel system.

In the room-and-pillar plan entries are driven 21' and the rooms 35' wide. The main entries are driven triple with a 50' pillar between entries. Cross entries are driven double and at right angles to the main entries every 500 feet with a 40' pillar between entries. Cross-cuts are driven through the entry pillars every 30 feet. Thirty-foot pillars are left between rooms and the rooms are driven 250' deep. The room-and-pillar plan is shown in Fig. 1.

In the panel system no rooms are turned from the cross entries, but stub entries are driven every 500 feet at right angles to the cross entries, thus dividing the mine into blocks or panels which are 500 feet square. Eight rooms are usually turned off the stub entries, leaving sufficient barrier pillars for the protection of the cross entries.

This system is shown in Fig. 2.

BLASTING.

In order to secure the maximum amount of lump coal the seam is undercut to a depth of 5-1/2' to 6' and brought down with a small charge of powder. The undercutting is done with Sullivan compressed air punching machines. Holes are bored by hand with post augers, the usual number being three, all bored straight in parallel with the rib and rarely slanting. About the center and half way up the seam a "buster" hole is bored while the remaining two holes go on each side of the "buster", but higher up and nearer the respective room ribs. The depth of the holes is usually about six inches less than the depth of the undercut. About 18 inches, or two pounds, of FF black powder is the usual charge for each hole. The powder is first placed in a cartridge made of heavy wrapping paper and then inserted in the hole. Fireclay is used for tamping. All tamping is done with a rod tipped with copper to avoid an accidental ignition

of the charge by coming in contact with sulphur balls or other hard foreign material in the coal seam. Only one shot is fired at a time, the "buster" first and then the "rib" shots. The charge is ignited with a squib, as fuse is never used in this district.

LOADERS, MACHINE MEN, ETC.

Two loaders are employed in a room and each machine cuts for six loaders. The loaders usually have two or more places, that is, two rooms or a room and a cross-cut. Loaders furnish their own tools, powder, squibs, oil, etc.; drill their own holes, fire their shots and are paid at the rate of \$.61 per ton. Each machine requires a runner and a helper. The machine runner is paid \$.065 per ton and the helper \$.06 per ton.

BOTTOM ARRANGEMENT.

Coal is caged from one side of the shaft only, that is, the South side, and the empties run to the North side. There is a double track on the South side for the loads, one for coal from the North and one for coal from the South. Coal can be placed on either cage from either track by means of a diamond switch. The track approaching the shaft and the one leading away have a 2 per-cent grade which facilitates the handling of both loaded and empty cars.

A plan of the bottom is shown in Fig. 3.

HAULAGE.

Empty cars are delivered to the inside partings from the bottom of the shaft by electric locomotives and from the partings to the rooms by mules. The loaded cars are taken from the room face to the inside partings and here picked up by the motors and taken to the bottom. Thirty-five pound rails are used on the motor and other haulage ways and twenty pound rails are used in the rooms. The track gauge is 42 inches. Locomotives pull twenty to twenty-five cars per trip.

UNDERGROUND STABLE

The underground stable accomodates the twenty-four mules used to gather the coal. It is equipped with a fire protection system which consists of a number of pipes provided with fusible plugs which melt at 150 degrees Fahrenheit. The stable is ventilated by a separate air split and is constructed entirely of concrete. No open lights are allowed and feed is brought into the stable in a fireproof car.

SURVEYING.

Extensions are made twice each year and the mine workings platted on a scale of 200 feet to the inch. Sights are always kept within 300 feet of the working face and are placed in entries only. They are carried over one rail and the track-layer is responsible for any deviation of the entry from the direction indicated by the sights.

WORKINGMAN'S COMPENSATION LAW.

The company has not accepted the Illinois Workingman's Compensation Law but has chosen to settle in case of an injury to an employee either by suit or out of court by special arrangement with the person concerned.

UNITED MINE WORKERS OF AMERICA.

The entire district is under the jurisdiction of the U. M. W. of A. and the agreement between the company and the miners which expires March 31, 1914, provides for the following scale of wages:

Top dumpers - - - - -	\$2.62
Top cagers - - - - -	\$2.62
Car trimmers - - - - -	\$2.62
Yardmen - - - - -	\$2.25
Blacksmith - - - - -	\$3.00
Firemen - - - - -	\$2.62
Mine examiners - - - - -	\$3.38
Tracklayers - - - - -	\$2.84
" helper- - -	\$2.62
Trappers - - - - -	\$1.25
Drivers - - - - -	\$2.84
Timbermen - - - - -	\$2.84
Bottom cagers - - - - -	\$2.84
Trip riders - - - - -	\$2.84

NARROW WORK.

Any passage way driven for development work in this district 20 feet or under constitutes narrow work and the miner is paid the regular price for loading and in addition the following prices:

10 ft. wide	- - - -	\$2.00	per yard.
12 " "	- - - -	\$1.94	" "
14 " "	- - - -	\$1.88	" "
16 " "	- - - -	\$1.81	" "
18 " "	- - - -	\$1.74	" "
20 " "	- - - -	\$1.50	" "

ROOM TURNING.

All rooms and cross-cuts turned entry width are paid the same as entries, no less than two yards entry price being paid for room necks where rooms are turned narrow.

ROOM WIDENING.

Room widening is paid according to the schedule below:

10 ft. wide	- - - - -	-\$5.08
12 " "	- - - - -	-\$4.60
14 " "	- - - - -	-\$4.12
16 " "	- - - - -	-\$3.63
18 " "	- - - - -	-\$3.15
20 " "	- - - - -	-\$2.66

WASHERY.

In undercutting the coal considerable fireclay from the floor is mixed with the machine cuttings which makes the fine coal practically worthless. To produce a marketable product a 600 ton Luhrig washery has been installed.

All coal three inches in diameter and under is carried to the washery by means of a drag conveyor and deposited in a raw coal bin of 250 tons capacity. From the raw coal bin the coal is delivered by automatic feeders to an elevator which supplies the coal to a set of concentric screens which separate the coal into five different sizes, namely, Nos. 1 and 2 nut coals and Nos. 3, 4 and 5 fine coals.

No. 1 coal passes through 3" round perforations and over 1-3/4" perforations; No. 2 passes through 1-3/4" round perforations and over 1" round perforations; No. 3 passes through 1" round perforations and over 3/4" round perforations; No. 4 passes through 3/4" round perforations and over 1/4" round perforations; No. 5 passes through 1/4" round perforations.

The two sizes of nut coal are sluiced directly to the nut coal jigs, and the Nos. 3, 4 and 5 to the fine coal jigs. The washed coal from the nut coal jigs is sluiced into draining screens, and from these deposited by gravity into the shipping pockets. The water passing through the draining screens which contains

some fine coal flows to the sludge tank at the bottom of the washery. The refuse from the nut coal jigs is crushed and treated on rewashing jigs, the clean coal from these jigs passing into the sludge recovery tank, and the refuse to the refuse elevator.

The clean coal from the fine coal jigs is treated similarly to the clean nut coal, the water passing through the draining screens flowing to the sludge recovery. The sludge recovery is merely a large settling tank in the bottom of which is a conveyor moving very slowly. The fine coal carried in suspension in the water, gradually settles to the bottom, and is taken to a draining elevator at the end of the tank, which raises the fine coal and deposits it in the shipping pockets. The water thus left reasonably pure is pumped from this tank and used over again in the washing process.

When the market for the larger sizes of washed coal is dull the Nos. 1 and 2 are crushed and prepared in the smaller sizes. The No. 5 coal is all consumed at the mine for fuel under the boilers.

ANALYSES.

Below will be found the results of analyses of the coal before and after washing:

	Nos. 2,3,4 Washed	No. 5 Washed	Mine Run
Moisture	10.00%	11.00%	10.00%
Vol. matter	36.00%	34.50%	31.55%
Fixed C	44.00%	42.00%	37.10%
Ash	10.00%	12.50%	21.35%
	<hr/> 100.00%	<hr/> 100.00%	<hr/> 100.00%
Sulphur (Separately)	3.50%	3.65%	5.00%
B. T. U. As Rec'd.	11,100	10,700	9,710
B. T. U. Dry	12,300	12,000	10,790

By virtue of the washing process it will be noted that the sulphur content is reduced approximately 35% and the ash content reduced approximately 50%, while the heating value of the coal is increased approximately 15%.