COAL MINING ON PITCHING SEAMS.

by

George MacMillan Brown.

A thesis submitted to the Department of Mining Engineering and the Faculty of the Graduate School in partial fulfillment of the requirements for the degree of Engineer of Mines.

1915.

Approved: ______________________
Department of Mining Engineering.

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A THESIS SUBMITTED TO THE FACULTY OF
THE SCHOOL OF ENGINEERING OF THE
UNIVERSITY OF KANSAS

for

THE DEGREE OF ENGINEER OF MINES

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PREFACE.

In the following dissertation on the subject of "Coal Mining in Pitching Seams" the writer desires to describe more particularly those methods of mining peculiar to coal mines in Oklahoma, with which he has been more or less familiar during the past three years.

He is also influenced by the belief that to the mining world in general very little is known of Oklahoma mines, and of the many difficulties which beset the operator in the safe and economical mining of the coal.

The subject matter of this thesis, therefore, will be a general description of ten or twelve Oklahoma mines, whose varying conditions offered a splendid opportunity for study and experiment.

The chapter on "Mine Surveying" has been added because the average mining graduate first begins his professional career as a surveyor. The methods shown have been used by the writer, and are rapid and accurate.

George M. Brown.

McAlester, Oklahoma,

April, 1915.

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LIST OF ILLUSTRATIONS

INTRODUCTION.

The description of the coal field, which will be given in this paper, is confined to that part of the Oklahoma coal field known as the McAlester-Wilburton district. This comprises all the coal outcropping from a point four miles west of McAlester to a point about four miles east of Wilburton, Oklahoma.

The writer had experience in various mines along these outcroppings, where the coal dipped from five to sixty-five degrees, so that the data given in the following pages will be descriptive of many different working conditions.

SEGREGATION OF INDIAN COAL LANDS.

Before taking up the general discussion of the subject let us first understand that in this field no operator owns his coal land, except in a few instances.

The coal rights belong to the Choctaw Nation as a whole and the land was set aside for mining purposes. An appraisal extending over a period of several years was made and all workable coal was segregated, except where by oversight a small tract here and there was left out.

The segregated coal rights were leased to different operators in tracts of 960 acres, and a royalty of 8 cents per ton is paid into the Indian Treasury.

As many leases have been worked out, a recent order of the Department of the Interior has allowed new leases adjoining the old leases to be taken up and worked.

In November and December, 1914, nearly all of the surface of the coal lands was sold at public auction, the operators retaining as much land as was needed to protect present and future operations.

Nearly all leases have fifteen years to run. What changes will take place then is difficult to forecast.

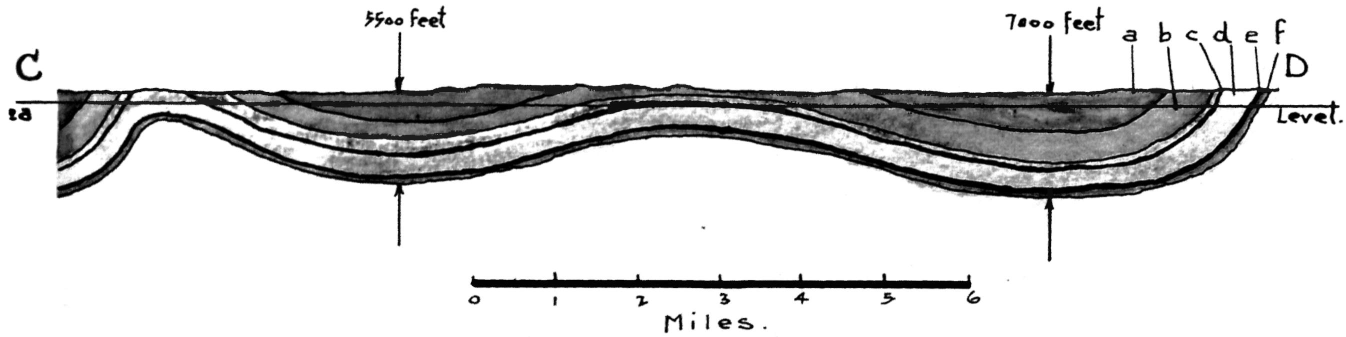
GENERAL GEOLOGY OF THE McALESTER-WILBURTON COAL FIELD.

Coal bearing rocks of the McAlester-Wilburton Coal Field all belong tothe Coal Measures of the Carboniferous Age. They were classified by Dr. Drake. There are four known workable beds of coal inthe district, of which the Lower Hartshorne seam occupies the lowest place in the measures. About an average height of ninety feet above the Lower Hartshorne seam the Upper Hartshorne seam is found. About twelve hundred feet above the Hartshorne seam and separated by several alternate layers of sand-stone and sandy shale lies the McAlester seam. Several hundred feet above the McAlester seam is found another small seam which, as yet, is unnamed but commonly called the Upper McAlester vein. Beneath the city of McAlester the Hartshorne seams are 2500 feet deep.

SECTION THROUGH STRATA SOUTHWEST OF MCALESTER

C- Near Mine Number 9, Baker

D- About 7½ miles Southwest of Haileyville



a- Boggy shale

b- Savanna sand stone

c- McAlester vein

d- McAlester shale

e- Hartshorne vein

f- Hartshorne sand stone

GENERAL DESCRIPTION OF THE COAL FIELD.

Hartshorne Coal.

In the McAlester-Wilburton district we will trace the Hartshorne coal from a point southwest of Haileyville northward and westward, and thence east to Wilburton. The chief characteristic of this coal bed is the heavy escarpment of sand stone, which accompanies the outcrop. South of Haileyville the coal dips about seventy-five degrees toward the northwest.

The coal outcrop is traced northeasterly to the town of Haileyville, then it swings toward the southeast through Hartshorne, then northeast to the small mining town of Gowan. There the coal makes a sharp turn and bears directly west to near the town of Buck. At Buck the coal is sharply faulted and folded and bears directly east to Wilburton. In all this distance the coal is workable, and has an average thickness of about four feet.

McAlester Coal.

South of Haileyville, owing to the steep dip, the outcrops of the McAlester and Hartshorne coals are very close together. They run almost parallel to a point about a mile south of Haileyville, where the McAlester coal bears more nearly northward through Dow. Just north of Dow the coal turns due west to Krebs, where it again turns north. About a mile north of Krebs the coal turns sharply west again and bears southwest to a point about five miles west of McAlester, where it makes a sharp turn and bears northeast through North McAlester. From North McAlester to Mine Number 7 of the Osage Coal and Mining Company the coal bed is badly broken and unworkable. At Mine Number 7 the coal again is normal and turns southward to Carbon. Just west of Carbon the coal turns due east to Wilburton. In nearly all this distance the coal is workable, and has an average thickness of four feet. See map of McAlester-Wilburton coal field.

Upper McAlester Coal.

Very little is known of the Upper McAleste. but apparently it is very much inferior in quality to the other coal. Its outcrop runs parallel to the McAlester seam south and west of McAlester. At the southwest corner of the City of McAlester, however, it turns southwest and parallel to the Missouri, Kansas and Texas Railway to the town of Savanna. At Savanna the coal apparently plays out.

Summary.

The following tabulations give the dip of the various veins at different points in the field under discussion:

Hartshorne Seams.

Location	Dip	Direction of Dip
Two miles South of Haileyville	75 degrees	Northwest
In Haileyville	8 to 20 "	North
One Mile east of Hartshorne	15 "	Northwest
Northwest of Gowan	10 "	South
Three miles north of Haileyville	15 "	South
At Buck	10 "	Southwest
At Carbon	75 "	North
At Adamson	35 "	North
Four Miles West of Wilburton	10 to 15 "	Northeast
One Mile west of Wilburton	5 to 12 "	North
In Wilburton	12 to 25 "	North

Hartshorne Seams- Continued.

Location	Dip	Direction of Dip
At Lutie	30 degrees	North
One Mile west of North McAlester	45 "	Southeast

McAlester Seam.

Location	Dip	Direction of Dip
Two Miles South of Haileyville	75 degrees	Northwest
One Mile Southwest of Haileyville	21 "	Southwest
Two miles west of Haileyville	17 "	West
At Dow	6 to 8 "	Southwest
One mile Northwest of Dow	10 "	South
One mile east of Alderson	12 to 15 "	South
At Alderson	5 to 10 "	South
One mile South of Krebs	6 "	West
One-half mile Northeast of Krebs	8 "	Southwest
One mile West of Krebs	10 "	Southwest
In McAlester	18 "	South
One mile West of McAlester	30 "	Southeast
Four miles West of McAlester	60 "	Southeast
Six miles West of McAlester	10 to 15 "	Southwest
Three miles Northeast of Krebs (Number 7 Mine)	10 "	Northeast
At Carbon	10 "	North
At Adamson	21 "	North
At Wilburton (unworkable at present)	15 "	North

Upper McAlester Seam.

This is worked only by small openings along the Missouri, Kansas and Texas Railroad. The dip is from 10 to 15 degrees west and northwest. This seam has not been worked with any commercial success.

COMPOSITION OF THE COALS.

The Hartshorne coal is a hard, compact coal of rather a sooty appearance around Haileyville, but of a high lustre at Wilburton. This, however, will depend on the character of the mine and whether the mine is wet or not. According to the United States geological survey (a), the Hartshorne coal has the following composition:

Moisture	1.68
Volatile Combustible Matter	41.00
Fixed Carbon	51.91
Ash	5.41
Sulphur	2.72
Phosphorus	.012

The Oklahoma geological survey report for 1914 gives the following analysis of the Hartshorne coal in general.

(a) Twenty-second Annual Report, Coal, Oil and Cement, page 384.

The results given below are the average of several:

Moisture	2.66
Volatile Combustible Matter	37.40
Fixed Carbon	52.61
Ash	6.08
Sulphur	1.23
B. T. U.	13704.00

McAlester Seam.

The McAlester coal is a highly lustrous, hard and friable coal, generally a much better quality than the Hartshorne coal for domestic purposes.

The McAlester coal is a good coking coal and coke ovens were operated extensively at Krebs and Alderson. The coke was shipped to old Mexico chiefly, but exportation was stopped by a heavy duty imposed. Since then no coke has been made in this field, except at the plant of the McAlester Gas and Coke Company.

In general I believe the Hartshorne coal is considered best for steam purposes, because it does not burn so freely as the McAlester coal. The United States geological survey (a) gives the following analysis of the Krebs- McAlester coal:

Moisture	2.18
Volatile Matter	29.79
Fixed Carbon	62.82
Ash	4.54
Sulphur	.67
Phosphorus	.014

The Oklahoma geological survey report for 1914 gives the following average composition of McAlester coal:

Moisture	2.54
Volatile Matter	36.63
Fixed Carbon	53.92
Ash	5.98
Sulphur	1.25
B. T. U.	13762.00

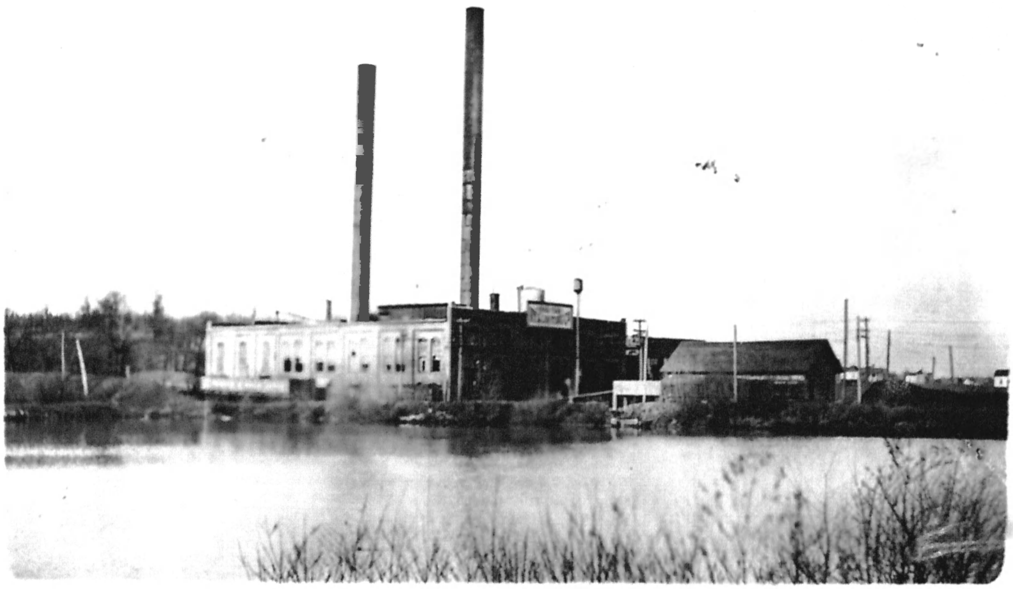
DESCRIPTION OF WORKING METHODS IN MINES.

As given before, this paper is confined to a description of those mines in which the writer has worked. However, the methods of working these mines is the general

(a) Twenty-second Annual Report, Coal, Oil and Cement, page 386.

SCENES IN McALESTER COAL FIELD

Power House of Choctaw Railway and Lighting Company



Mine No. 5, Krebs from the west

plan upon which all the mines in this district are worked. The following description is given of each mine as a separate unit:

Mine Number 9, Baker,

Great Western Coal and Coke Company.

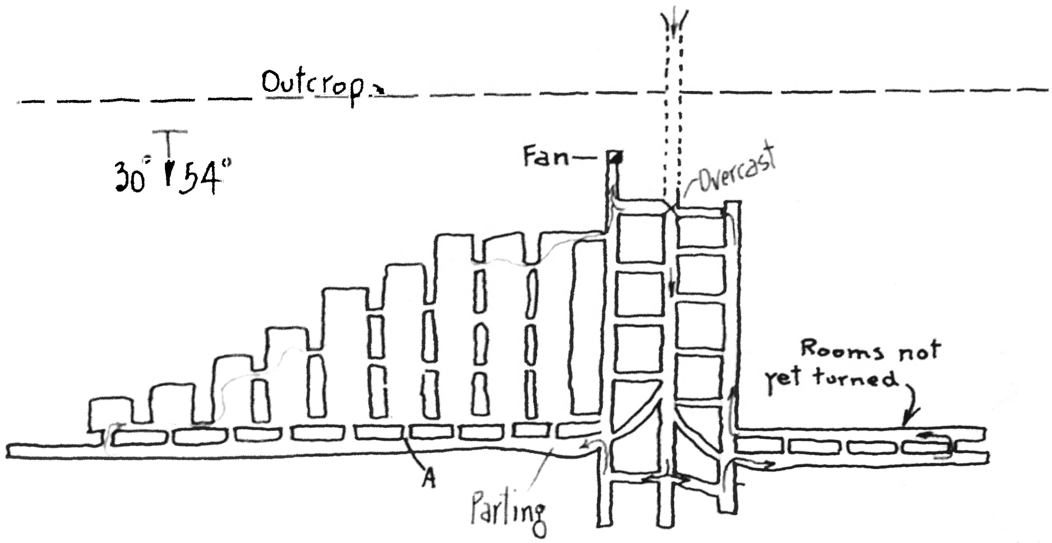
Mine Number 9 is located on the outcrop of the McAlester vein about four miles west of McAlester. The coal here is 4 feet 9 inches thick. The mine is worked by slope driven straight down the dip. The slope bears about south 13 degrees east. Owing to the steep dip at the surface a 330 foot tunnel was driven on a dip of 35½ degrees to intersect the coal where the dip was found to be 54 degrees. The dip of the coal at the surface was nearly sixty-five degrees, hence the tunnel. At the necessary depth on the slope, entries are turned off at right angles to it. A small barrier pillar was left along the slope air course for protection to the slope. See figure 1 .

It might be well to state here that the mining law of Oklahoma requires that a slope air course must be driven on each side of the slope and that break-throughs shall be made through from the slope to the slope air course at intervals not to exceed 40 feet. On the entries the double entry system is compulsory, the air course being driven parallel to the haulage entry and break-throughs made between the two entries every 40 feet.

Just inside of the barrier pillar mentioned above, Number 1 room is turned off the entry at right angles to it. Owing to the steep dip of the coal in this mine the lower entry, or air course, as it might be called, was left out. In this case the haulage entry would be the air course, and the first break-through between the room would constitute a return air course for the air.

In turning off the room the neck of the room was driven up narrow for a distance of 15 feet, and then widened out to a width of 24 feet. The coal being very steep, the room was allowed to fill with coal, thus acting as a sort of bin, from which coal was drawn into the cars below by means of a sliding door. Break-throughs in the room were made very 40 feet, the pillar between each room being about ten feet, therefore, the room was driven on about thirty-fhree foot centers and no room could be turned until connection had been made between the two rooms outby.

The method of mining the coal was simple. The miner merely kept his place timbered and shot all the coal off the solid. The dip being very steep the coal fell to the bottom of the room, from which it was drawn into cars. Naturally the coal was badly broken, and a great deal of slack was made, also all of the bottom and loose rock which was broken up was loaded into the cars and rendered the fine coal almost unsalable. All haulage was done by mules who hauled the coal from the room out to the parting near the slope. From the parting the main haulage rope on the slope pulled it out of the mine. See figure 1 .



Ideal plan of working at Baker No.9. Samples No.2

The first breakthrough is used as an upper entry. Chute doors are placed at the bottom of each room as at A. Ventilation shown →

Figure 1.

As was usual in slope mines of this dip the steam haulage engine was a direct connected, first motion engine with drum. On a steep pitch like this a 1¼ inch rope was used to haul not over four loaded cars of coal, or rock. The dip was so steep that covers had to be made to hold the coal in the cars, and the mules were left in the mine because it was difficult to bring them out of it. The output of the mine was never more than 200 tons.

Owing to the difficulty of working this seam, the large amount of gas evolved and the very bad roof in the lower working, this mine was abandoned in December, 1913.

Reference to the mine map accompanying this report will show the unusual conditions in the strata at this mine. A careful study of the map will give much information regarding the geology and structure of the rocks.

The following condensation of facts will give the reader a few ideas of the difficulty of operation:

Gas, bad roof, a dip of 54 degrees in the workings, much water and a fire clay bottom.

Mine Number 2,

Samples Coal and Mining Company.

This mine is located about one mile west of McAlester on the McAlester vein. The dip is 35 degrees at the surface and 21 degrees at the sixth lift. The direction of dip is south 13 degrees east. The coal is 4 feet 2 inches thick, and is worked on the room and pillar plan. The mine has six lifts at present, which are turned off the slope at right angles. The entries are driven on a water level and the slope straight down the dip.

The method of mining is the same as at Baker, except that on account of the lower dip flat sheets have to be placed in the room so that the coal will slide down to the mouth of the room, where it is loaded into the cars. On a dip as low as 30 degrees double entries are driven for ventilation and haulage, as stated before, the break-throughs being made as required by law.

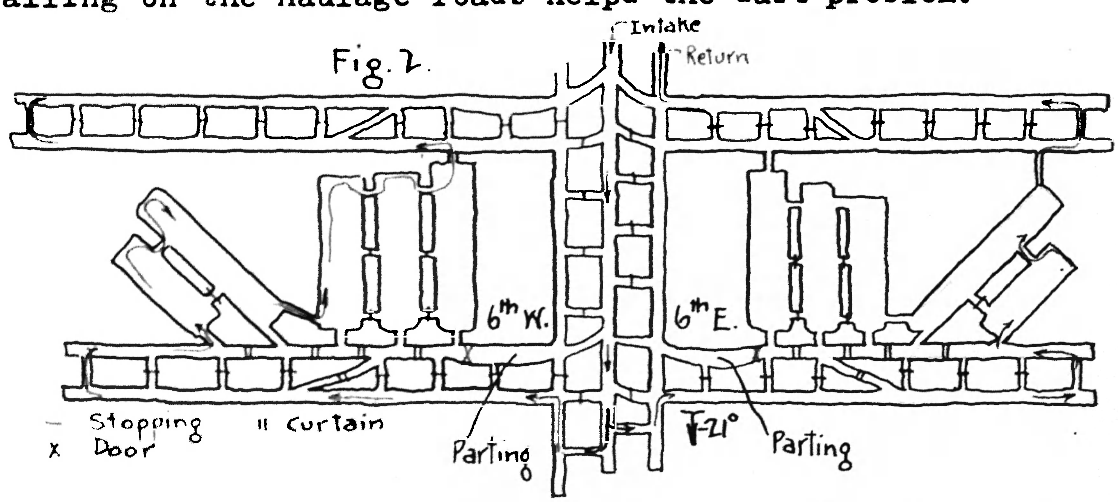
The coal is all shot from the solid, except in a few places or rooms, where Sullivan compressed air post punchers are used. Where the coal is undercut permissible explosives are used. On all solid shooting black powder is used. It might be said right here that black powder has caused more fires, explosions and deaths than any other one thing in Oklahoma mines, with the exception probably of falls of rock. However, under ruling of the United States Bureau of Mines black powder will probably eventually be excluded from all mines on Indian lands.

On the lower entries, owing to the decrease in the amount of dip, much trouble was encountered in getting the coal from the room face to the entry, because the coal would not slide and the rooms were too steep for tracks to be laid in them. After much persuasion the writer induced the operators of the mine to drive the rooms across the dip on a grade of 11 degrees and to put tracks in them. Of course this necessitated driving the rooms on sights, which was done. The venture has proven a success, and the coal is put out in much better condition.

Number 2 Samples has always been a source of worry to the operator on account of the dirt and rock which mixed with the coal in the chutes. The amount of rock loaded out was great on account of a draw slate 8 inches to 12 inches thick, which came down with the coal. It is believed a small washer plant and rooms across the dip will help the condition of the coal very materially.

This mine has always been gaseous enough to be dangerous, and the dust of the coal must always be wetted down with water. However the shale from the draw slate falling on the haulage roads helpd the dust problem.

Fig. 2.



Plan of working Samples No. 2, showing change from chute rooms to track rooms across pitch. Ventilation in red. Main split thus

Mine Number 5,
Osage Coal and Mining Company.

This mine is located just east of McAlester, and is worked through a shaft 480 feet deep, and by a blind slope. The mine is on the McAlester seam, whose thickness at this point is 4 feet. The seam at this place is unusual in that it is very uniform in quality in thickness and in the absolute lack of folds or faults of any kind whatever. This mine was started about 1895.

On first being opened the mine was worked on a long wall plan with circular face. When the diameter of this circular face had reached about two thousand feet the long wall plan was abandoned, owing to slack times and the quality of the labor to be had. It was then opened up on the room and pillar plan. In working a shaft mine it is usual to work both up hill and down hill, a slope being driven to the dip and a plane to the rise, entries being turned off at right angles on each. The rooms are all driven nearly straight up the dip, except where the dip is less than 5 degrees. In the latter case rooms are sometimes driven down the dip.

In the early working of the room and pillar plan in this mine no attention was paid whatever to barrier pillars in the main workings. In the lower parts of the mine, however, owing to the heavy overburden, it was found necessary to leave protective pillars along the slope and between every tenth room, as shown on the accompanying map of the mine.

In 1912 a severe squeeze came on and threatened to ruin the mine. It was found necessary then to leave the barrier pillars all around the lower workings and to increase the size of the pillars along the slope. This was done, and so far has proven successful.

A plan is now under way to rob the pillars on the advancing plan. The rooms at first were turned on 50 foot centers, the rooms being 24 feet wide, and the pillar 26 feet wide, the room track being in the center of the room. This plan was suggested by Mr. S. K. Smith, a consulting engineer of St. Louis, Missouri. It was thought advisable, however, to so arrange the room that there would not be so much yardage in break-throughs, so now one pair of rooms is turned on 60 foot centers, and the next pair on 40 foot centers, only one break-through is made through the large pillar, and all remaining break-throughs are made in the small pillar. This cuts down the yardage cost materially, and still allows good ventilation. It is to be understood in this connection that all of the coal in this mine is undercut by electric chain machines, and the coal is shot down by Black Diamond permissible explosive.

It is the plan to rob the pillars on the advancing system, making the line of break about forty-five degrees with the entry. I cannot say much more in detail about the plan, as it has not been tried out to any great extent at this time.

In April, 1912, a severe explosion destroyed the west slope of this mine and greatly curtailed the output. At present the output is 475 tons from one slope. The west slope, however, is being cleaned up and a larger future output is assured.

This mine has always been unfortunate in explosions and fires and the last explosion caused the sealing up of the mine for 3½ months.

The following tabulation will give a concise description of the remaining mines in this field in which I worked:

Mine Number	Location	Railway Connections
1	Haileyville	C. R. I. & P.
2	Haileyville	C. R. I. & P.
4	Lutie	C. R. I. & P.
2	Wilburton	C. R. I. & P.
3	Wilburton	C. R. I. & P.
7	Richville	M. K. & T.
8	Krebs	M. K. & T.

The tabulations given on pages 19 and 20 occupy the same relative positions as given for the mine numbers on page 18, for instance: Items in third column on pages 19 and 20 refer to Mine Number 4, Lutie.

Operating Company	Seams Worked	Geologic Series
Hailey-Ola Coal Co.	1	Carboniferous
Hailey-Ola Coal Co.	1	Carboniferous
Hailey-Ola Coal Co.	1	Carboniferous
Great Western C. & C. Co.	1	Carboniferous
Great Western C. & C. Co.	1	Carboniferous
Osage Coal & Mining Co.	1	Carboniferous
Osage Coal & Mining Co.	1	Carboniferous

Name of Seam	Thickness	Dip	Direction of Dip
Lower Hartshorne	4'6"	12 to 20	North
Lower Hartshorne	4'6"	21 to 31	Northwest
Lower Hartshorne	4'8"	25 to 30	North
Upper Hartshorne	4'6"	15 to 23	North
Upper Hartshorne	4' 3"	12 to 21	North
McAlester	3'	5 to 12	Northeast
McAlester	4'2"	5 to 6	Northwest

Gaseous ?	Entrance	Depth of Shaft	Length of Slope
Very	Shaft	380'	2000'
None	Slope		1500'
Medium	Slope		2000'
Medium	Slope		2200'
Medium	Slope		3300'
Medium	Slope		3700'
Medium	Shaft	265'	4900'

Average Output	Kind of Tipple	Type of Cage	Type of Fan
650 tons	Wood	Self Dumping	High Speed
350 tons	Wood		Slow Speed
500 tons	Wood		High Speed
200 tons	Wood		Slow Speed
300 tons	Wood		High Speed
250 tons	Wood		Slow Speed
250 tons	Wood	Self Dumping	High Speed

Speed of Fan	Lights Used	Wet or Dry?	Haulage System
150 r. p. m.	Open	Medium	Mules-Slope rope
75 r. p. m.	Open	Very wet	Mules-Slope rope
125 r. p. m.	Open	Wet	Mules-Slope rope
75 r. p. m.	Open	Medium	Mules-Slope rope
150 r. p. m.	Open	Dry	Mules-Slope rope
60 r. p. m.	Open	Dry	Mules-Slope rope
180 r. p. m.	Open	Dry	Mules-Slope rope

Method of Blasting	Explosives Used	Kind of Roof
By shot firers	"Black Diamond" Black Powder	Shale-good
By shot firers	"Black Powder	Shale
By shot firers	Black Powder	Shale
By shot fiers	Black Powder	Shale-good
By shot firers	Black Powder	Shale-good
By shot firers	Black Powder	Shale-godd
By shot firers	Black Powder	Shale-good

Dynamite and permissibles are used to some extent in all.

ITEMS ENTERING INTO COST OF PRODUCTION.

In order that the reader may understand somewhat the many items which enter into the cost of production of coal in Oklahoma mines, I am tabulating here those items which are usually found on the earning and expense sheets of local coal companies:

Inside Labor

Foreman
Timber and Track Men
Drivers- Trappers
Cagers- Pushers
Shot Firers- Gas Men
Slope Cleaners- Rope Riders
Pumping
Master Mechanics
Electricians
Miners
Entry and Airway Yardage
Room Yardage
Driving Slope
Other Miscellaneous Labor

Outside Labor

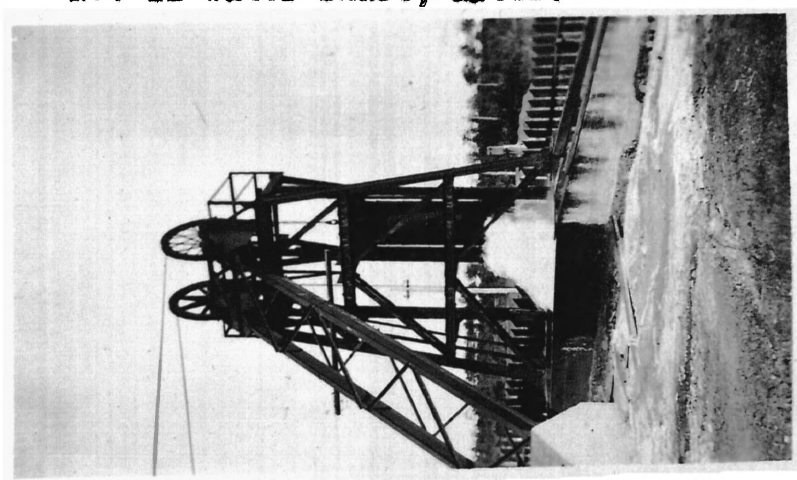
Yard Boss
Engineers- Firemen
Weighmen
Car Trimmers
Dumpers
Smiths- Carpenters
Stables- Teams
Miscellaneous Expenses

Other Expenses

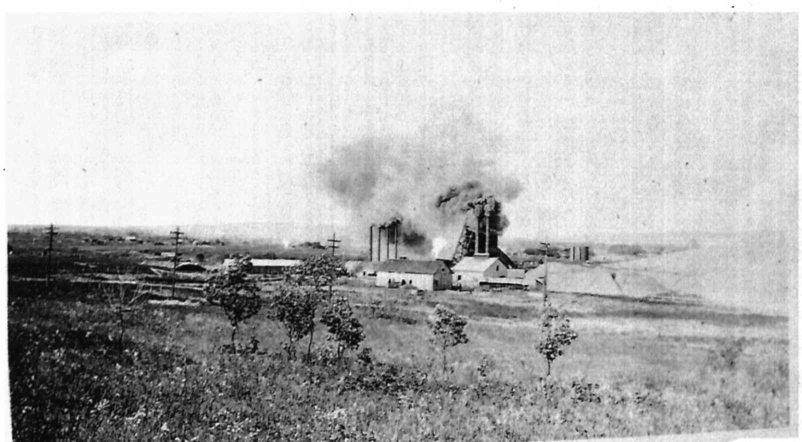
National Royalty
Lease Royalty
Mine Timbers
Wire Rope
Steel Rails
Livestock- Feed
General Office Expense
Interest
Boiler Coal
Missellaneous Supplies, such as
Oil, grease, packing, waste, etc.

Mine No. 1, Haileyville.

No. 11 Water Shaft, Krebs.



Mine No. 5, Krebs, From the south.



VENTILATION.

The most important phase of coal mining in the eastern Oklahoma coal fields is the problem of ventilation. When we consider the amount of air entering some of the large mines of the East, we may consider the problem of ventilation here as insignificant, but such is not the case. It must be remembered that the thickness of the coal bed and the depth of overburden have something to do with the case.

In Oklahoma the coal is thin, the roof bad and in general entries and air ways must be driven narrow, so that the cross sectional area of air ways is small. The friction on the air is greatly increased with the result that high water guage pressures are common.

Just to give an idea of the ventilating apparatus used and its results, let me quote here a few figures on mine ventilation in this field:

Mine Number	Company	Type of Fan	Diameter	RPM	Vol.	W.G.
1 Haileyville	Hailey-Ola	H.S.Sullivan	10'	150	55000	1½"
5 Krebs	Osage	" "	10'	230	35000	2-7/8"
6 Buck	McAlester C. & C. Co	" "	10'	330	50000	5½"
8 Krebs	Osage	" "	10'	180	30000	1¾"
2 McAlester	Samples		20'	80	30000	1½"
3 Wilburton	Great Western C & C Co.	" "	10'	150	40000	1½"
4 Adamson	Union Coal Co	" Jeffrey	10'	125	5000	1¾"

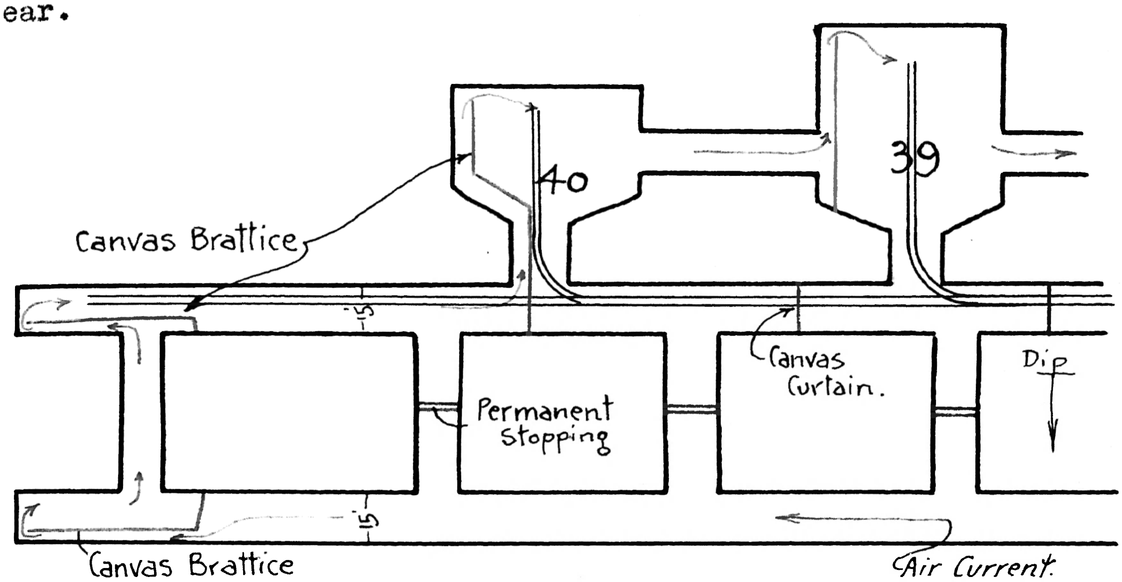
H. S. - High Speed W. G.-Water Guage.

On account of the pitching seams the mines are driven to the dip to a great extent. Taking advantage of the fact that warm air rises, the ventilation is ascensional. The air generally is taken in at the shaft, or slope mouth and carried to the bottom of the slope before it is split. In simple form one split of the air traverses the workings on one side of the slope. The other split traverses the other side and is joined to the first split by being carried over the intake through an overcast. Usually this overcast is near the fan. See page 12.

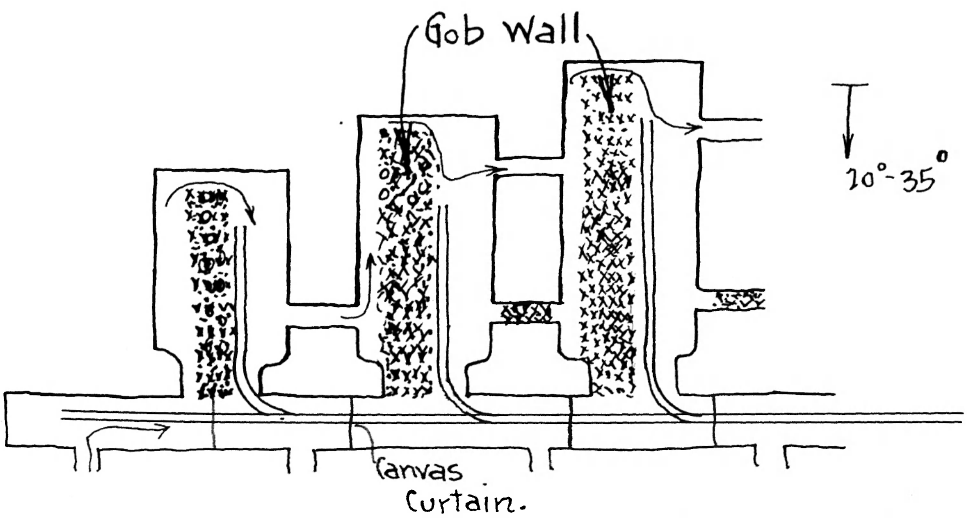
In driving entries on the double entry system the following plan of ventilation is used: (See page 12.)

The two entries are driven parallel to each other at a distance apart depending on the depth of overburden. The distance is seldom more than 40 feet. At intervals of not more than 40 feet cross-cuts are driven between the two entries. The open cross-cut behind is now closed with a stopping of wood, stone or brick. This forces the air current to go through the open cross-cut ahead. In general the air goes in the lower entry and out along the top entry.

If the mine is gaseous the lower entry will be bratticed up with a canvas curtain along its lower side from near the face outby, and across the entry outside of the open cross-cut. This forces the air to sweep the working face and to carry off and dilute the dangerous inflamable gas evolved. The upper entry will be worked the same way. Reference to the accompanying drawing will make this point clear.



Plan of Ventilation of Working faces of a coal mine, showing also method of laying tracks in entries and rooms.



A plan of Ventilation used in mines with drawslate
Note: Chutes are used on dips above 20°.

The rooms are usually turned up the dip and at right angles to the entry. Break-throughs are made between them not over forty feet apart for ventilation. Rooms are turned on from 30 feet to 50 feet centers depending on the overburden. It must be kept in mind that the air current must sweep across the working face. Failure to observe this point has caused many deaths. Obviously, where the cross-cuts are from 30 to 40 feet apart, the face is not always right at the face, so that curtains of canvas must be used. As soon as a new cross-cut is made the one behind must be closed up.

Obviously the entries cannot be closed up when new rooms are turned so canvas curtains are hung up across them to prevent the air going straight outby along the entry. Where there are several parallel pairs of entries, rooms are driven through between them to shorten the distance the air must travel.

In winter when the cold air enters a mine its temperature is raised. This causes the air to absorb the moisture in the mine to such an extent that the dust from the coal becomes very dry. On this account explosions may result from dust ignition. Ignition of the dust may be caused by short circuited electric cables, blown out shots and premature explosion of powder or dynamite. For these reasons the law requires that all mines must be kept wet.

In an article of this description one must necessarily be brief, so in the following pages I will give a few general notes on the various mines with which I am familiar.

GENERAL NOTES ON MINING.

In Mine Number 5 at Krebs, Sullivan and Morgan-Gardner electric chain machines are sued for undercutting all the coal. The total cost of electricity per month is less than $100.

The coal is shot down with "Black Diamond" permissible explosive.

The machines undercut about one hundred tons per day.

Electric current is received from the Choctaw Railway and Lighting Company and is taken down into the mine through a drill hole 860 feet deep. This hole was located by the writer. At the bottom of the hole are two 75 k. w. a. c. transformers 2300 v. 235 volts.

Pumping is maintained by using electric driven pumps. On account of the great head (1200) the water is pumped from one level to another up the slope until the level of the shaft is reached. The water then is pumped out 490 feet vertically.

Steam hoists are used for the main haulage except at the bottom of the slope where small electric hoists are used. These latter merely gather the coal at the bottom of the slope. On the entries mule haulage is used.

The average rate of haulage on slope is 750 - 1000 feet per minute.

Because Mine Number 11, Krebs, was flooded by water breaking in from flooded strip pits along the outcrop, Mines Numbers 5 and 8 Krebs were also endangered, all of the mines having been connected. (See maps of Krebs district in pocket at back of book)

In order to keep the water out of Number 5 in particular a deep water shaft was sunk at the bottom of Number 11 slope. This shaft is rectangular, 5 feet by 10 feet and is 793 feet deep. The water is hoisted out in two 1000 gallon skips.

The hoist is a Lidgerwood electric with a 6 foot 8 inch drum driven by two 175 h. p. General Electric direct current motors.

The operation of this water shaft presents many new problems, but they cannot be described in a paper of this length.

Mine Number 8 Krebs has one of the longest slopes in Oklahoma. The slope is 4900 feet long and eighteen car trips are hauled up a pitch of 6 degrees.

Steam hoists are used for main haulage ropes and mules on the entries.

Part of the coal is mined by Sullivan iron clad A. C. chain machines. Part is shot off the solid with black blasting powder. Power for the machines is brought into the mine through a 750 foot drill hole located by the writer.

Pumping in the lower part of the mine is done with electrically driven pumps. The water is pumped out through drill holes.

Mine Number 7 Richville is located near the limits of the workable coal bed just north of Carbon, Oklahoma. The coal dips northeast and swings gradually around to a southeast dip.

The coal is not so thick as at Numbers 5 and 8 Krebs, and has a thin parting of bony coal on top.

The mine is operated by an open mouthed slope 3700 feet long.

Mine Number 1 Haileyville is located right in the railway yards of the Chicago, Rock Island and Pacific Railway. The mine has a shaft 380 feet deep and two blind slopes. The roof is hard and full of sulphur streaks, which make the mine water very acid.

I believe the gaseous condition of this mine is caused by an impervious strata of iron rock a few feet above the coal. Some parts of the mine are very gaseous.

Mules are used for entry haulage.

Post punchers driven by compressed air are used in entry headings. To eliminate danger of fire there Monobel permissible is used.

Mine Number 2 Haileyville is fairly steep, and very wet. In fact, it is one of the wettest mines in the state. The water is very acid and an iron rail lasts only a short time. The pumps are worn out so quickly that the water boxes are used to haul the water up the slope.

Chute rooms only are worked in this mine. The dip on the south side is about sixty degrees.

Mine Number 4 Lutie is a well maintained mine, worked on the chute room, room and pillar method. The conditions are good and a daily output of 500 tons is maintained.

The mine is medium gaseous, but all of the eastern Oklahoma mines are inspected for gas every morning by licensed gasmen.

Mines Numbers 2 and 3 at Wilburton have been closed down for 18 months and the present outlook is very poor in regard to their ever being opened again. The conditions were good while in operation and the coal produced was of very good quality.

CONCLUSION

In a discussion of such a broad subject as Coal Mining on Pitching Seams the writer is necessarily limited in his selection of details for a paper of this kind. Therefore, he has dealt with the most important items, describing them with words and drawings, with the view in mind of giving information to only those readers who are somewhat familiar with the subject. Attention is called to the numerous drawings in the back of the book. The following is a list of the drawings which represent good practice in this field:

Map of Number 5 mine Krebs,
Osage Coal and Mining Company,
Scale 1" - 200 feet.

Map of the McAlester-Wilburton Coal Field,
Scale 1" - 1 mile.

Details of Number 5 Shaft, Krebs.

Section of Strata,
Mine Number 11 Water Shaft Krebs.

Wilburton-Lutie Coal Field,

Scale 1"- 1000 feet.

Mine Workings around Krebs,

Scale 1" - 1000 feet.

McAlester- Krebs Coal Field,

Scale 3" - 1 mile.

Map of Baker Number 9,

Scale 1" - 100 feet.

Two small sketches of ventilation methods at Mine No.8

Krebs.

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Twenty-Second Annual Report,

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Senate Document Number 390.

CHAPTER ON SURVEYING

SURVEYING METHODS

In the following notes on Mine Surveying it is taken for granted that the reader has been trained somewhat in surveying and in the ordinary uses of the various instruments, therefore, the methods used by the writer will be somewhat condensed.

Many mining engineers favor strongly the reading of angles by the method of continuous azimuth; that is, by making the reading of the last foresight the zero of the next backsight, reading clockwise. In this manner the bearing of the line is taken direct from the instrument without calculation.

No doubt the method has its advantages, but in low coal the setting of the plate is liable to be shifted, and it usually is, by one's bumping and crawling through passages. Of course, this necessitates a new setting of the plate. This, of course, will not take up the small error involved and is no better than any other method.

It is my belief that there is less chance of error when the plate is set at zero for each reading, because we have a distinguishing mark there. For that reason I prefer, and use, the plain azimuth method reading clockwise. See figure X . Each forward bearing must be computed, but that is a minor consideration, which involves little loss of time.

TAPING

In taping distances in ordinary mine work I have always measured to the nearest .05 foot which I consider accurate enough for all mine surveys, excepting plumbing of shafts where it is necessary to measure to the nearest .01 foot.

On surface surveys for land boundaries, location of buildings or tracks, I measure to the nearest .1 foot.

PLOTTING

In plotting surveys on mine maps the coordinate system only should be used. The use of the protractor should be confined to smaller and less important maps than mine maps.

EQUIPMENT

In going into a mine to survey I usually have two assistants, one of whom should be the gas-man. He is used as helper, and also to go ahead and examine the workings for gas. In Oklahoma mines this is a "safety first" precaution, and a good one.

The general equipment needed for mine surveying is as follows:

A good transit, reading to single minutes;

200 foot tape with ends graduated to .1 foot;

A pocket magnifier;

EQUIPMENT- Continued.

Small fence staples for spads;

A quantity of 1 inch wooden plugs;

A carpenter's ordinary brace;

A steel bit fashioned after a miner's ordinary drill;

Carbide lamps, where safe;

A small hatchet;

Three plumb bobs;

A pocket tape;

A few pieces of chalk.

As the slopes are driven on sights, the center line is usually extended as a tangent. Holes are drilled, where possible, in the solid roof and the wooden plugs driven into them, the approximate line having been given the foresight man by extending the old line. The exact line is determined by driving in the spad, or staple, and bending to line by sighting on plumb bob string. Never use cross timbers for any except intermediate stations, as they are easily bent out of line by weight of the overburden.

In sighting it is best to sight on plumb bob strings as far as they can be readily seen. For illuminating the strings use a piece of tracing cloth held just in front of your lamp and immediately behind the string facing the instrument.

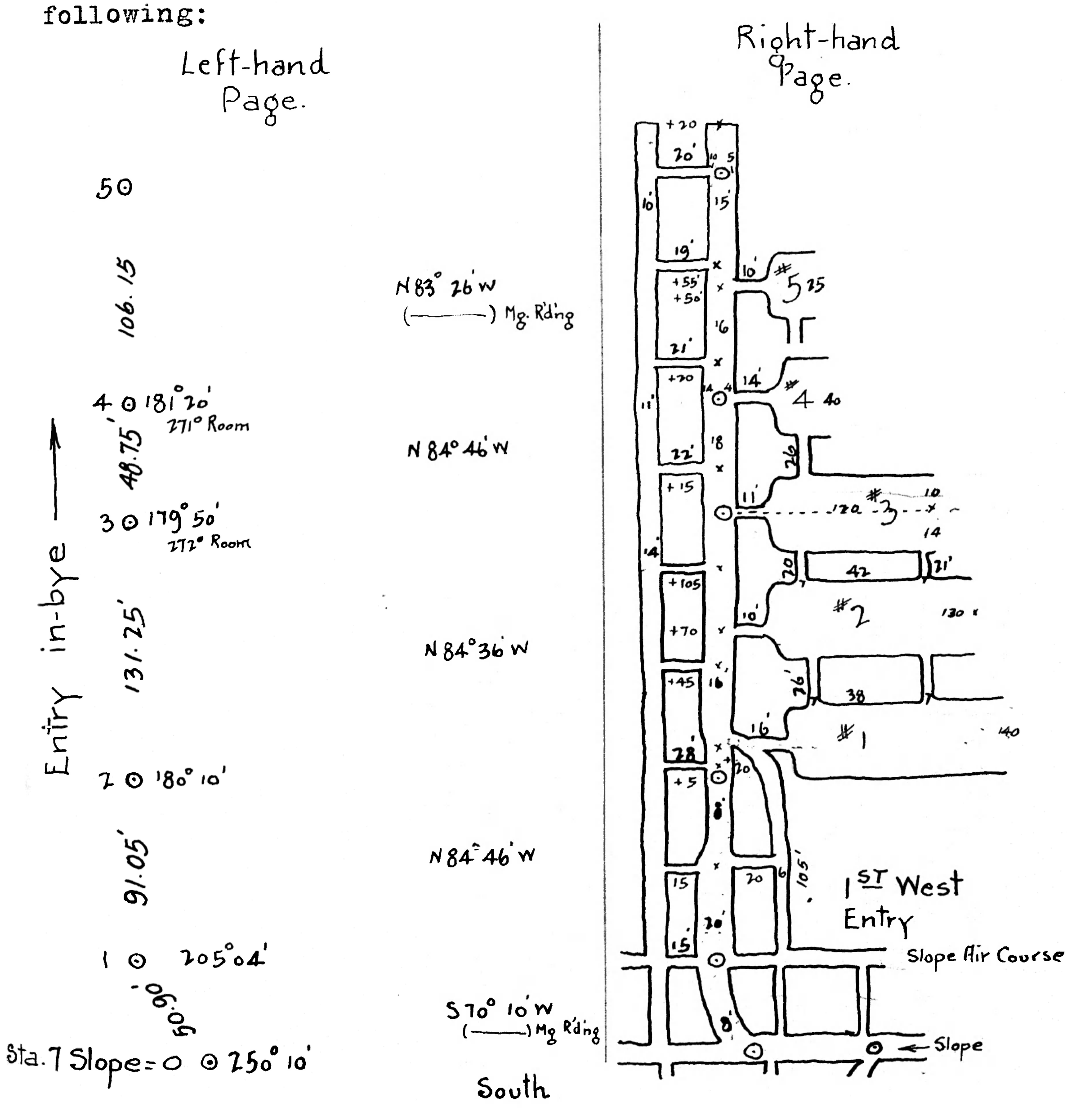
In putting up sights for driving new work the plugs are driven about three feet apart and spads driven in them in the desired direction. When the sight plugs are too far apart the strings cannot be readily seen by the foreman when he extends his line of sight to the face.

In traversing the entries, which are usually crooked on account of being driven level, the foresight man goes ahead and picks out suitable locations for the foresight station. In crooked entries his good judgment will save much time. However, he must always keep in sight of the instrument man. He hangs upthe entry curtains or brattices, but he should never hang up more than one or two at one time if the mine is gaseous. A short-circuited air current may result in a miner's being burned at the face by the evolved gas. In this connection surveys should be made at night or on idle days if at all possible.

In the actual recording of the survey, first set plate at zero, backsight to string behind clamp, lower motion, loosen plate, turn clockwise in azimuth to foresight string and read angle. Record angle in note book and measure distance. After recording distance, read angle again. Of course, on important work it is best to double angles. All surveys should be closed wherever possible. It is obvious that where reading to single minutes the tape should not be read to .01 foot.

It is a good plan to number stations in order down the slope from zero up. Station 7, for instance, at the mouth of a certain entry would be the zero for the entry survey and would have the same latitude and departure.

In recording the notes use the left hand page for recording angles and distances. The right hand page is used for sketches. A sample of notes is given in the following:



In plumbing shafts I use the method best suited to the conditions. Where only one opening is available I use two wires in one shaft, lining in instrument on both top and bottom. To do this a good plan to follow is:

Hang one wire over a groove in strong timber laid over the shaft buntings and spiked down in the proper place on the ground landing of the shaft and sight instrument to it. Now place other wire approximately on line over a notch in another heavy timber spiked down. The wire can then be jarred into line by hitting timber with a heavy hammer. Now go underground and have the surface helper lower the wires down. When they reach the bottom attach plumb bobs weighing 15 to 25 pounds, and allow them to swing free in large buckets of oil.

An approximate line for the instrument can be obtained by stretching a string along the wires. Set up instrument and shift center to coincide with both wires. This is a tedious undertaking, and requires much patience, especially if the shaft be wet. After getting a good coincidence between the wires and the instrument, allow them to stand for several minutes. If still in line they are no doubt correct, if the distance apart is the same at both top and bottom of shaft.

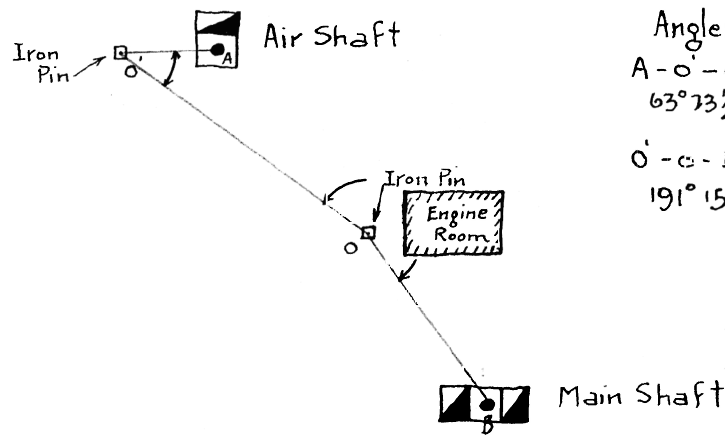
Where both air and hoist shaft are accessible it is best to hang one wire in each shaft and to traverse between the wires. The wires are simply hung, as stated before. There is no check, however, but absolute accuracy.

The following are sample notes on a shaft plumbing operation involving both methods. The notes are actual ones taken in a recent survey for a connection between two mines. They will give a better idea of the methods involvd.

Plumbing of No. 9 Shaft. Dow Okla.

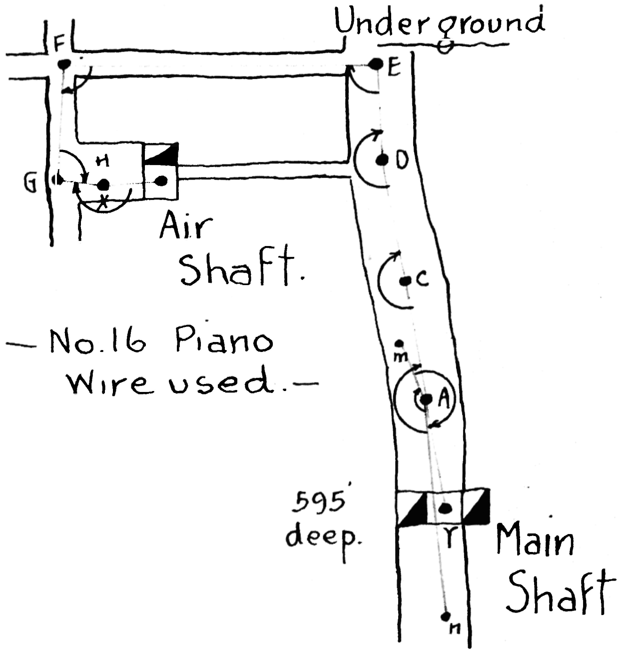
2-wire 2 shaft method.

Surface.



Angles	Distances
A-O'-O 63°23¼'	O'-A 28.72'
O'-O-B 191°15¼'	O'-O 160.35
	O-B 104.61'

Underground

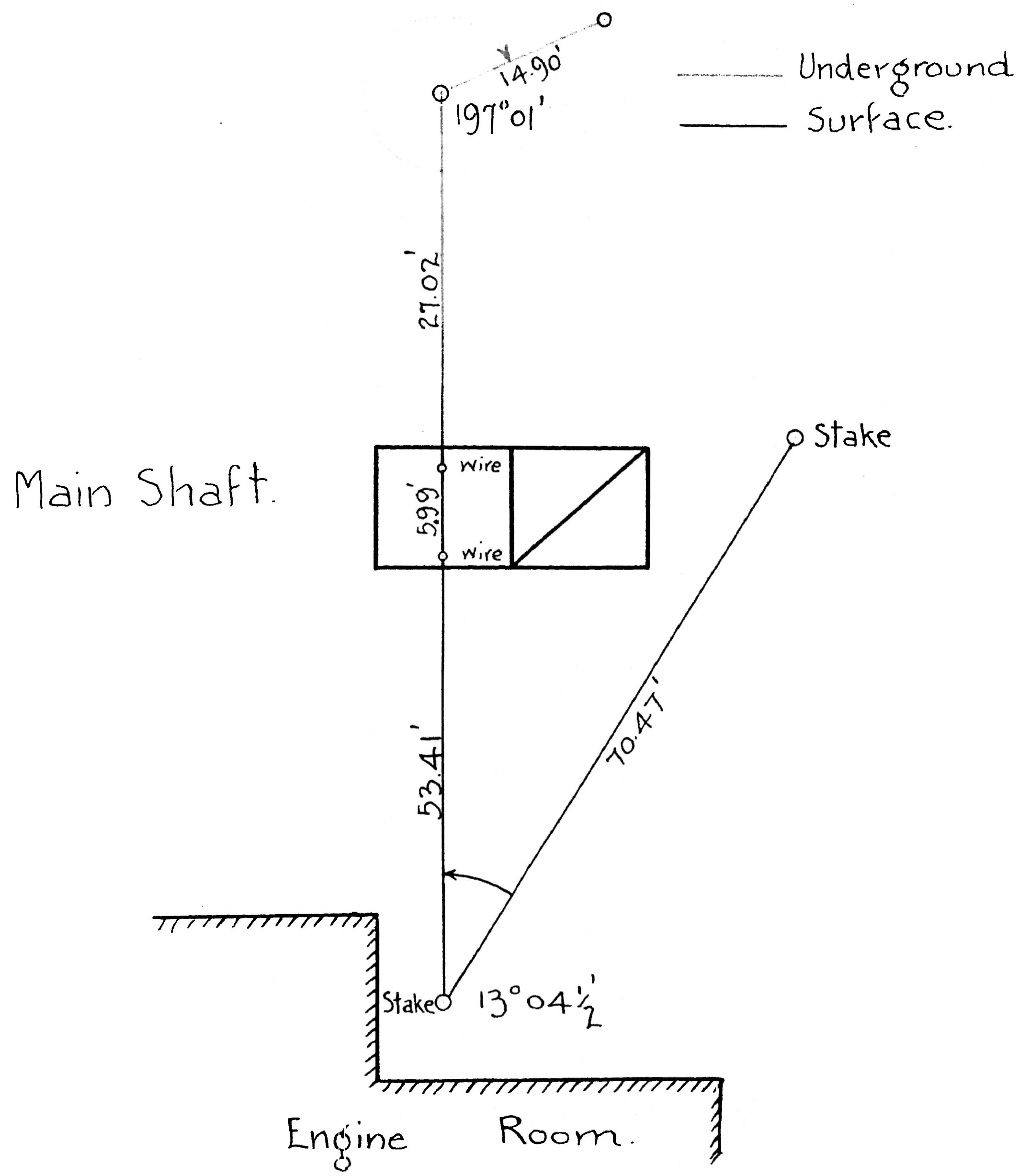


Angles
M-A-Y 173°02½'
N-A-M 184°53½'
N-A-C 186°14'
A-C-D 187°01½'
C-D-E 167°38'
D-E-F 101°23½'
E-F-G 105°06'
F-G-H 79°10'
X-H-G 183°44½'

Distances	
N-A	97.35'
A-Y	57.70'
A-C	128.30'
C-D	72.25'
D-E	50.92'
E-F	61.15'
F-G	58.30'
G-H	29.07'
H-X	23.57

Plumbing of No. 2 Shaft, Dow Oklahoma.

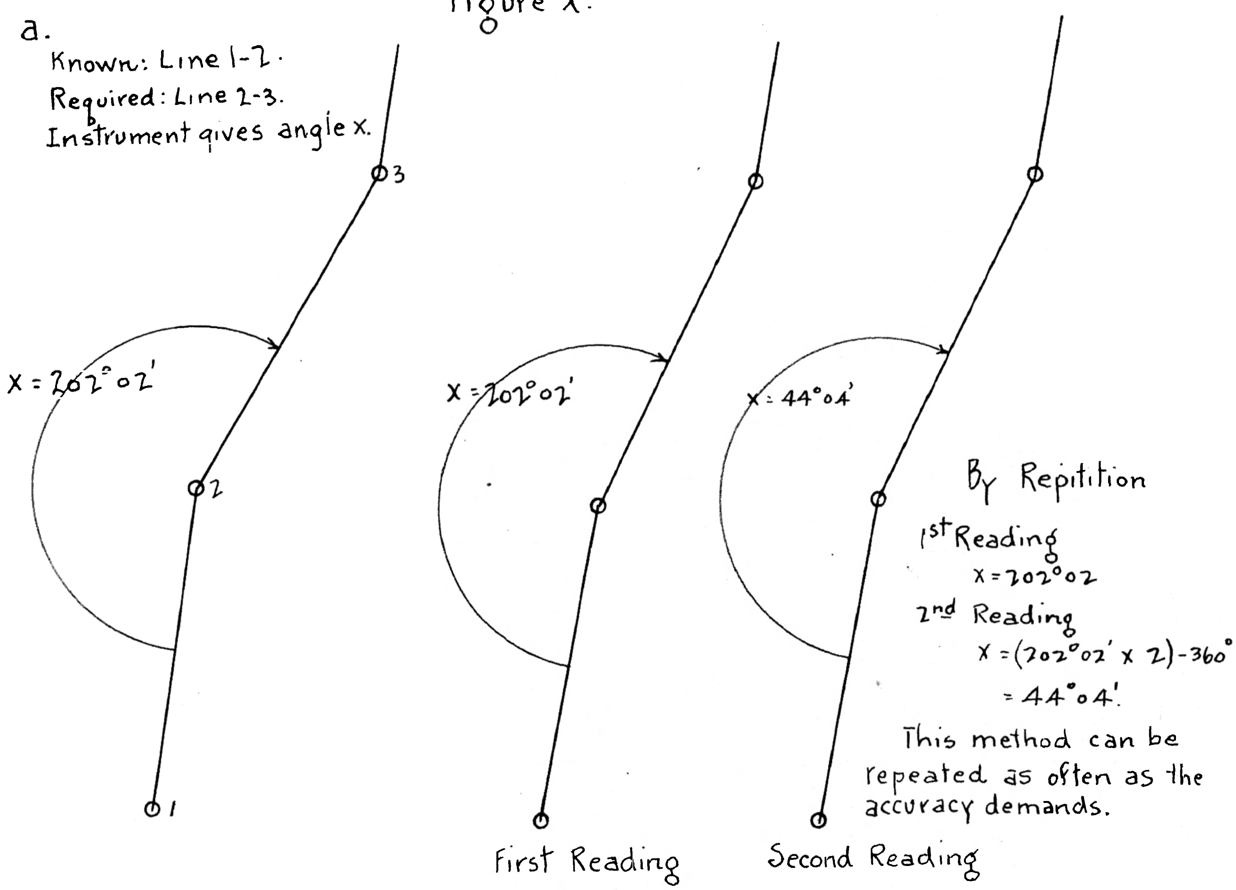
One shaft, two wire method.



The method of keeping mine survey notes shown before is simple and it has the advantage of being a more or less detailed map of the mine when completed. This allows one to refer to his note books for details that cannot be readily shown on mine maps. Of course the amount of detail notes taken in the surveys will be governed by the kind of survey, value of the coal and the scale to which the map will be drawn.

The plumbing methods given are standard, and I do not believe they can be improved. Careful and accurate work is a prime necessity.

Figure X.



GLOSSARY OF TERMS

Commonly Used Around Oklahoma Mines.

Dip - The inclination of a coal seam from the horizontal.

Strike- A horizontal line at right angles to the dip.

Ventilating Current - The current of air forced into a mine to furnish fresh air to the miners and mules and to remove the foul gases evolved.

Slope - The main haulage way out of the mine.

Parting- A place in the mine with two parallel tracks where the mine switching is done. A parting may be near the slope or further inby.

Room - A place where the miner mines the coal. Differentiated from heading in being driven wider.

Heading - Usually the face of an entry.

Entry - Designation for haulage way.

Air Course - A passageway for the air current.

Gas - An inflammable mixture of methane (CH_4) and air.

Rope-rider - An employee who rides all car trips on the slope.

Trapper - An employee used to open and close ventilating doors.