A REPORT
ON
THE ELECTRIC MINE
BY
ARCHIE LEWIS VOIGHT

THESIS
FOR THE
DEGREE OF BACHELOR OF SCIENCE
IN
MINING ENGINEERING

COLLEGE OF ENGINEERING
UNIVERSITY OF ILLINOIS
1912
VIEW SHOWING TIPPLE AND POWER HOUSE.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I Introduction</td>
<td>1</td>
</tr>
<tr>
<td>II Situation and Surroundings</td>
<td>1-2</td>
</tr>
<tr>
<td>III History</td>
<td>2</td>
</tr>
<tr>
<td>IV Property Holdings</td>
<td>3</td>
</tr>
<tr>
<td>V Topography</td>
<td>4</td>
</tr>
<tr>
<td>VI Geology</td>
<td>6</td>
</tr>
<tr>
<td>VII Quality of Coal</td>
<td>13</td>
</tr>
<tr>
<td>VIII Method of Opening and Working Mine</td>
<td>13</td>
</tr>
<tr>
<td>IX Timbering</td>
<td>18</td>
</tr>
<tr>
<td>X Mining at the Face</td>
<td>20</td>
</tr>
<tr>
<td>XI Accidents</td>
<td>24</td>
</tr>
<tr>
<td>XII Haulage</td>
<td>24</td>
</tr>
<tr>
<td>XIII Drainage</td>
<td>29</td>
</tr>
<tr>
<td>XIV Ventilation</td>
<td>29</td>
</tr>
<tr>
<td>XV Preparation of the Coal</td>
<td>31</td>
</tr>
<tr>
<td>XVI Disposition of the Product</td>
<td>34</td>
</tr>
<tr>
<td>XVII Surface Plant</td>
<td>36</td>
</tr>
<tr>
<td>XVIII Statistics</td>
<td>39</td>
</tr>
<tr>
<td>XIX Recommendations</td>
<td>43</td>
</tr>
<tr>
<td>XX Conclusion</td>
<td>44</td>
</tr>
</tbody>
</table>

1. Rates for labor.

2. Cost of mining.

3. Value of Plant.

XIX Recommendations                          | 43   |

XX Conclusion                                | 44   |
INTRODUCTION.

The purpose in making this report was the study of mining conditions and method of mining at the Electric mine, the preparation of the coal and its marketing; the cost of mining and the value of the plant, together with the geology and topography of the region. As the mining conditions throughout the Danville district are practically the same, a study of the conditions and methods of mining at one mine will suffice for all. The geology was studied with reference to its effect on the method of developing the mine and carrying on mining. The preparation of the pyrite was studied not as allied to the work of the mine, but because of the fact that this is one of the few places where pyrite from coal seams is prepared for market.

SITUATION. The Electric Mine is situated in Section 10, Township 19 North, Range 12 West of the 2nd P.M., in Vermilion County, Illinois. The nearest town is the village of Hillery, which is about half a mile east, and the nearest large town is the city of Danville, which is about three miles east of the mine. Danville is a city of about 30,000, and is the location of the offices of the Coal Company. Vermilion County is a part of the Fifth Inspection District of Illinois, which comprises the counties of Christian, Edgar, Macon, Moultrie, and Shelby, as well as Vermilion. The Vermilion County field is known generally in the market as the "Grape Creek Field", as most of the mines in the county are working the coal bed known as the "Grape Creek" bed.
This field lies south of Danville, and takes its name from Grape Creek, which runs into the Vermilion River a few miles south of Danville. The Electric Mine is not working the Grape Creek coal, however, but is mining a shallower bed, known as the "Danville" coal. The general name of the field, however, is the "Grape Creek" field.

SURROUNDING MINES. There are no mines operating in the immediate vicinity of the Electric. The Missionfield and the Gray stripping mines are about two miles west. In January, 1912, the working of the Electric ran into the workings of an abandoned mine, near the boundary of the Electric property. The exact extent of this old mine is not known, as it was never mapped.

HISTORY. The shaft was sunk in 1903, and the mine began hoisting coal in the same year. This was the first mine on the property, and no other has since been sunk. Since the time of sinking there have been complete suspensions in the following years: 1906, three months, 1910, three and one-half months, 1912, one month. These were strikes or suspensions while wage scales were being adjusted for the state. The coal company, individually, has had no labor troubles. Aside from the suspensions given above, the working of the mine has been continuous, with the idle days usual at coal mines.

The total production of coal, and its value, with the amounts of the various grades, by years, is as follows:

The total production of coal, and its value, with the amounts of the various grades, by years, is as follows:
<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>Mine</th>
<th>Lump.</th>
<th>Slack</th>
<th>Other grades</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>end-</td>
<td>produc-</td>
<td>run.</td>
<td></td>
<td></td>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>June</td>
<td>ing.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30'</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1904</td>
<td>51,384</td>
<td>49,384</td>
<td>2,000</td>
<td></td>
<td></td>
<td>62,230</td>
</tr>
<tr>
<td>1905</td>
<td>105,104</td>
<td>105,104</td>
<td></td>
<td></td>
<td></td>
<td>110,359</td>
</tr>
<tr>
<td>1906</td>
<td>81,292</td>
<td>81,292</td>
<td></td>
<td></td>
<td></td>
<td>93,485</td>
</tr>
<tr>
<td>1907</td>
<td>137,682</td>
<td>137,682</td>
<td>18,500</td>
<td>2,700</td>
<td></td>
<td>123,731</td>
</tr>
<tr>
<td>1908</td>
<td>73,721</td>
<td>22,136</td>
<td>34,989</td>
<td></td>
<td></td>
<td>104,320</td>
</tr>
<tr>
<td>1909</td>
<td>207,495</td>
<td>16,385</td>
<td>146,169</td>
<td></td>
<td></td>
<td>44,941</td>
</tr>
<tr>
<td>1910</td>
<td>170,241</td>
<td>9,560</td>
<td>92,585</td>
<td></td>
<td></td>
<td>68,096</td>
</tr>
<tr>
<td>1911</td>
<td>179,358</td>
<td>2,178</td>
<td>115,437</td>
<td></td>
<td></td>
<td>61,734</td>
</tr>
<tr>
<td>July</td>
<td>1911</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>to 1,1912</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>1,1912</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1156,277</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1270,981</td>
</tr>
</tbody>
</table>

**PROPERTY HOLDINGS.** The Company has worked out and is working 325 acres in Sections 9, 10, 15, and 16. Of these, 175 acres in Section 10, and 40 acres in Section 9 are owned by the Company, and in the remaining 110 acres the coal right only is owned by the Company. The land owned in fee was paid for at the rate of $100 per acre. The coal right to 55 acres in Sections 9 and 10 cost $85 per acre, while the coal right to the 55 acres in Sections 15 and 16 cost the company $40 per acre.

1Figures from 1904 to 1911, inclusive, from Illinois Coal Report.
All the surface owned by the company is used as farm land, and rented at grain rent, the income being about 5 per cent of the investment in this land.

The coal is taxed at $35. per acre, and the farm land at $65. per acre. The Vermilion County rate on coal is the highest in the State, and the rate on the Grape Creek or No. 6 coal is even higher than that on the Danville or No. 7 coal.

All the deeds to the land owned are in the name of the coal company.

TOPOGRAPHY. The Vermilion River is the main drainage channel of the Danville region. This river belongs to the Wabash River system, which empties into the Ohio, which in turn empties into the Mississippi. The Vermilion River is formed by the union of three streams known as the North Fork, Middle Fork, and Salt Fork. The name Vermilion River is commonly applied only to the portion below the junction of Middle and Salt Forks. This is about four miles west of the junction with the North Fork, which empties into the main river just west of Danville. The workings of the Electric Mine are situated north of the main branch, about one mile east of the junction of the Middle and Salt Forks.

The surface of the property is a prairie, with a little timber in the western portion. This is mostly scrub oak and hickory. The prairie slopes gradually to the west until it nears the Vermilion River, changing there to a rapidly descending bluff. On the south the slope is gradual for about a mile, then there is a rapid descent of about forty feet to the river valley, which at this point is a broad amphitheater.
GENERAL SECTION AT ELECTRIC MINE.

"a," SECTION THROUGH COAL NO. 7.

"b," SECTION THROUGH COAL NO. 7.

FIG. 1

1" = 50

"a"

Coal 14'
Sandstone 18'
Sandstone 14'
Fire clay 18'
Limestone 2'
Shale 60'

1" = 1'

Pyrite 1/2
Coal 3'
Clay 1'
Coal 4'

1" = 1'

Fireclay
Coal 60'
The valleys of the Vermilion River and its tributaries are in general narrow and deep. These have destroyed much valuable farming land of the prairies through the sharp backward cutting of the streams and have been decided barriers to easy transporation. The valleys, while generally narrow, in some places swell out into broad amphitheatres, a mile or more in width. They vary in depth from 50 to 150 feet, and their walls are steep and somewhat precipitous.

There are no streams on the mining property itself, but it is cut by several gullies or ravines, which, however, are shallow, and have not affected the working of the mine.

The elevation of the town of Hillery as determined by the State Geological Survey is 651 feet above sealevel. This is approximately the surface elevation of the mine, although there is a slight slope westward from Hillery.

GEOLOGY. The rocks near the surface in the neighborhood of the Electric Mine belong to the McLeansboro formation of the Carboniferous period. A log of the shaft boring, with the geological formations is shown in Fig.1. The coal bearing rocks in the region lie in the great shallow basin of the Eastern Interior Coal field, which comprises the greater part of Illinois, and parts of Indiana and Kentucky. The greater part of the Illinois Coal measures lie in a spoon shaped basin with its longer axis in a northwest-southeast direction, and with its deepest portion in the southeastern part of the state. This basin has for its eastern border the LaSalle anticline, which runs southeastward from LaSalle, in northern Illinois, to the Wabash River. The coal beds of the Danville region lie east of this anticline, and are separated from the main Illinois basin by
By reason of this division, the Danville or Grape Creek field is a part, practically, of the Indiana field. The slope of the coal measures in the Danville region is generally to the east, indicating that they lie on the slope of the Indiana basin, which is bordered on the west by the LaSalle anticline.

The workable coal beds of the Danville region are those designated by the Illinois State Geological Survey as Coal No. 6, and Coal No. 7. Coal No. 6 is known in this region as the Grape Creek coal, and Coal No. 7 as the Danville Coal. This latter is the bed worked by the Electric Mine. The areas of best development of these two beds do not coincide. It seems that where one bed is of good quality and of sufficient thickness to be workable, the other is either too impure or too thin to be mined profitably. The geological map accompanying this report shows in general the areas covered by the two coal beds, and the localities in which they are worked.

The Danville Coal, or Coal No. 7, lies from 20 to 80 feet above Coal No. 6. Owing to erosion and deep cutting of the Vermilion river in pre-Pleistocene time, this coal bed is confined chiefly to the region west and southwest of Danville. The southeastern limit of the coal is along an irregular line extending from a short distance east of Georgetown to Danville. The northeastern limit is not well determined. The presence of the coal has been shown by wells northeast of Danville, but it seems likely that the coal here has suffered extensive erosion and is to be found only in isolated areas. For this reason successful mining northeast of Danville is doubtful.

At Danville Coal No. 7 outcrops all along the river
front in the southwestern part of the city, and also for a short
distance north along the North fork, but soon disappears here, hav­
ing been eroded. From the point where the coal outcrops below the
Wabash Railroad Bridge it can be traced up the River to near the
mouth of Butter Branch, where it dips below the level of the river.
It is now almost impossible to see the outcrop of the coal in the
vicinity of Danville. It has been stripped and also worked by drift
mines, and its outcrop is marked by heaps of refuse, but the coal it­
self is not visible. Through the distance from Danville west, the
thickness of the coal is about 5 1/2 to 6 feet. The workings of
the Electric Mine are just north of Butler branch, and the coal out­
crops along the southern end of the property. From this point the
coal dips slightly northward. This dip is due most likely not to
the structure of the rocks, but to differences in thickness of some
of the adjacent beds.

In the neighborhood of the mine the rocks are covered by
about forty feet of drift material. Below the drift is a bed of
sandy shale about fifty feet thick, and under this, and just above
Coal No. 7, is a soft gray shale, of thickness varying from six in­
ches to two feet. In places this shale contains considerable iron
pyrites. The gray shale is in general the cap rock for the coal
throughout the mine, but in a few localities the cap rock is a hard
black shale, which has a thickness varying from six inches to one
foot. The coal has an average thickness of 5 1/2 feet. Under the
coal there is five feet of fireclay, and beneath this about eighty
feet of sandstone and shale. At a depth of about 172 feet from the
surface there is a thin bed of coal, which is about 1 1/2 feet
thick, and at a depth of 298 feet there is a split seam, its upper
FIG. 2. SKETCH OF TYPICAL ROLL OR "HORSEBACK."

1" = 4'
bench being 3 feet thick, and its lower bench being 2 feet 4 inches thick, the two being separated by 3 feet of clay and shale. This seam corresponds to Coal No. 5 of the state section, and the higher coal may be No. 6.

The strata of this region are uniform, but while there are no faults, the coal beds are cut by many so-called "rock faults" or "horsebacks" occurring as rolls in the top of the coal. These are a feature of this region, and are one of the chief hindrances to cheap extraction of the coal. A cross-sectional view of a typical roll is shown in Fig. 2.

The origin of these rolls is in doubt. Two theories as to their origin have been advanced, namely, (1) that the rolls are the result of erosion of the coal beds and subsequent deposition of sand or shale in the erosion channel; (2) that the rolls are due to strains in the coal and its overlying strata while the coal was in a lignitic state, the outlying strata being forced into the coal by the forces set up.

The chief advocate of the erosion theory has been Mr. Geo. H. Ashley of the U. S. Geological Survey. In an article in "Economic Geology", Vol. II, No. 1, on the "Maximum Rate of Deposition of Coal", he gives two illustrations of rolls and says, "Evidently an erosion, or open water channel, existed in the top of the partly consolidated coal bed previous to the deposition of the regular roof. Sand was washed into this, and at the same time stringers and films of carbonaceous matter were also carried out into the sand filling. Then the normal shale roof was laid down."

Dr. T. E. Savage, of the Illinois State Geological Survey, is the champion of the second theory. In an article in Economic
Geology Vol. V, No. 2, on "Clay Seams or So-Called Horsebacks near Springfield, Illinois", he describes clay seams which penetrate the coal bed in a nearly vertical direction. He says, in part, 

"...as the mass of vegetal material, under the weight of overlying sediments was slowly transformed into coal, there would be somewhat unequal contraction in different parts of the seam, owing to the lack of homogeneity of the vegetal materials making up the coal beds... As long as the materials possessed some degree of mobility, the unequal shrinking in the different parts of the coal seam would be equalized by the movements of some of the mass... When the consolidation reached a certain point such adjustment would be no longer possible. After this, the continued unequal shrinkage of the vegetal mass would cause unequal strains in the roof of the coal under its load of superimposed sediments". The nature of the beds above the coal is considered to be the chief factor in determining whether clay seams, which penetrate the coal bed, or rolls in the top of the coal shall be formed. In case the roof is a hard brittle shale or limestone whose particles do not possess the mobility to adapt themselves to the strain, the result would be a fissuring of the hard shale or limestone cap rock and the coal bed, and if there was a soft shale above, this would flow down into the fissure. This is the case in the Springfield district. In case the roof is a soft or plastic shale, the mobility of the particles would permit the shale to adjust the inequalities resulting from contraction of the coal. Such adjustment would be the formation of rolls by the squeezing into the coal of the soft shale. This flowing of the shale would relieve the strains to such an extent that the coal would not be fissuered, but merely compressed, or pushed back.
The roof of the coal in the Danville region is a soft shale which possesses the plasticity required to take up the strains and from rolls, and apparently that is what has been done. In case rolls are formed, movement must take place. That movement has taken place is proven by the slickensides at the contact of coal and shale. Also the presence of stringers of coal in the rolls points to compression, as compression would naturally force the coal into the shale and vice versa. The presence of stringers seems a point against the erosion theory, as it seems that flowing water would carry away such loose fingers or streamers of coal, and leave a clear body of shale or sandy after deposition. The coal likewise shows no signs of weathering at the contact, as would be the case had it been once a stream channel. Another point in favor of the compression theory is the fact that the coal is thicker at the edges of the roll, seeming as if the coal had been pushed back and piled up at these points. Two points in favor of the erosion theory are (1) the fact that the rolls are frequently quite wide, some reaching 18 or 20 feet in width; (2) none of them penetrate the coal bed. These facts could be taken to indicate a wide, shallow stream channel. The preponderance of facts, however, and particularly the nature of the roof, seem to indicate that the compression theory is the logical one for this particular locality.

The length of the rolls is indefinite and there is no known regularity in the direction in which they extend, nor in the distance between them. For this reason their occurrence cannot be known in advance of striking them, and no way of avoiding or mining around them is possible.
QUALITY OF THE COAL. The coal is a black, lustrous, bituminous coal. As mined the coal is fairly clear from clay or shale, and sulphur, although the seam contains a clay-sulphur band about 8 inches above the bottom of the coal, and sulphur balls occur irregularly. These impurities are excluded by the miner when appearing in seams more than one-half inch thick. The coal contains considerable calcite interlaced along the cleavage planes. The coal breaks into fairly large lumps, little slack or fine coal being made. This is a non-coking coal. Presence of iron and sulphur in the coal is shown by the reddish-brown color of the ashes. Most of the coal is used for steaming purposes, and for burning brick. An analysis made at the University of Illinois is as follows:

<table>
<thead>
<tr>
<th></th>
<th>Air-dried</th>
<th>As received</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P.c.t.</td>
<td>P.c.t.</td>
</tr>
<tr>
<td>Moisture</td>
<td>2.31</td>
<td>12.76</td>
</tr>
<tr>
<td>Volatile Matter</td>
<td>44.66</td>
<td>39.89</td>
</tr>
<tr>
<td>Fixed Carbon</td>
<td>41.73</td>
<td>37.26</td>
</tr>
<tr>
<td>Ash</td>
<td>11.30</td>
<td>10.09</td>
</tr>
<tr>
<td>Sulphur</td>
<td>4.38</td>
<td>3.91</td>
</tr>
<tr>
<td>CO₂</td>
<td>0.68</td>
<td>0.61</td>
</tr>
<tr>
<td>B.T.U.</td>
<td>12,493</td>
<td>11,106</td>
</tr>
<tr>
<td>B.T.U. of pure coal,</td>
<td>14,773</td>
<td></td>
</tr>
</tbody>
</table>

METHOD OF OPENING AND WORKING MINE. The hoisting shaft is 100 feet deep and 8 ft. by 16 ft. inside dimensions. It is timbered with pieces 4 inches thick and of variable width (averaging 8 inches) down to the rock, and from the beginning of the rock to the bottom with pieces 3 inches thick. Buntons 6 inches by 3 inches divide the shaft into two hoisting compartments, and there is also
SHAFT BOTTOM.
a compartment for pipes and wires. The sand beds above the coal contain a great amount of water and to collect this a water ring was built, from which the water is carried by pipes to a pump at the shaft bottom. From this sump the water is pumped out of the mine. This water from the sand beds is of good quality and is used in the stable for watering the mules, and also for drinking purposes by the men at the bottom. The air shaft is situated 250 feet south of the hoisting shaft. The air shaft is 6 feet by 12 feet in size, and has two compartments, the airway being 8 feet by 6 feet in size and the stairway 4 ft. by 6 ft. Between the airway and the stairway a partition is constructed of one inch boards, nailed to the buntons, and covered with 3-4 inch boards to make the partition airtight.

The shaft bottom entry is 16 feet wide, and maintains this width for a distance of 70 feet. All the mine workings lie south of the hoisting shaft, and all the coal is caged from the south side. The entry contains only the one track for the loaded cars, but by means of a switch at the shaft bottom cars can be loaded on both cages. On the north side of the shaft is an automatic carlift, which will be described later, for handling the empty cars. From the carlift, the empty cars run into a run around from which they are taken back into the workings. The shaft bottom entry is timbered with eight inch and ten inch timbers, the roof timbers being lagged with smaller pieces.

The first cross entries were turned off the main entry 400 feet south of the shaft. With rooms driven up 120 feet, almost 300 feet of coal was left as a shaft pillar, and for support of the surface buildings. The mine stable is built in this pillar, on the west side of the main entry. There are 21 stalls, built on each
side of a central passage way or feed entry, each stall being for one mule only. The walls of the stalls are the coal, and the roof the top rock of the mine. As this is weak the stalls are timbered. Fire protection is secured by a water pipe running along each row of stalls. Along these pipes are placed valves, which are kept closed by a metal plug. One valve commands each stall. The plugs will melt at a temperature of about 135° F. and release the valve allowing a spray of water to play over the stable. A chemical fire extinguisher is kept in the stable.

From the shaft bottom the mine is laid out on the double entry system. The main entries (haulage way and air course) are driven seven feet wide. The height varies on account of the way the top rock falls, but in general the height from floor to roof timbers is about five and one-half feet. This is about the height of the coal. The timbers are placed above the top of the coal, but the floor heaves badly, and thus decreases the height of the entries. The pillar between main entries is 15 feet wide generally, but close to the shaft bottom the pillar is 21 feet thick. Crosscuts are made at intervals of 60 feet, in conformance with the State law. Four hundred feet from the hoisting shaft, as before stated, the first pair of cross entries were turned off the main entry. Beginning with these first cross-entries, pairs of cross-entries were turned off the main entries at intervals of 260 feet. These cross-entries are driven six feet wide, and a pillar 12 feet wide is left between them. Cross-cuts between main entries are 60 feet apart, as on main entries. From each of the cross entries, rooms are turned off on 30 foot centers and driven up 120 feet, or until they connect with the rooms from the next pair of entries. The
FIG. 3.
GENERAL PLAN OF ROOMS, SHOWING SPACING OF PROPS.
1" = 20'

Room Length 120'
rooms are turned six feet wide and the room neck made nine feet long. The rooms are then widened out to their full width, which is 21 feet. The rooms are usually widened out on the inbye side. With room centers 30 feet, and rooms 21 feet wide, a nine foot pillar is left between rooms. Crosscuts between rooms are driven to conform with the State law regarding crosscuts between rooms. A plan of a room, showing dimensions, timbering, and general plan is given in Fig. 3.

TIMBERING. The timbering throughout the mine, both in entries and rooms, is one of the most important factors in the working of the mine. This is on account of the poor roof, which consists of a soft shale, covered by a sandy shale, as described in the section under "Geology". This roof shale is very weak and is loosened up by blasting and by the moisture and air, and begins to come down soon after a working place is opened up. The entries must be well timbered in order to keep them clear of rock.

There are two general methods of timbering on the entries, as shown in Figs. 5 and 4. The system used in the three stick timber set system. On the main south entry, a great deal of the timbering is as shown in Fig 5. The timber sets are placed about two feet apart, and the legs of the set extend to the floor. Lagging is frequently placed behind and above the timber sets, on account of the loose rock. The size of the timber used in these sets varies but will average 6 inches in diameter on the main entries, 4 inches on the cross entries, and 8 to 10 inches on the partings. Round timbers are used in most cases, but split timbers are used when round pieces of the proper size are not to be had.

Probably two-thirds of the timbering in the mine is of the
FIG. 4. METHOD OF TIMBERING WITH SHORT LEG SETS.
style shown in Fig. 4. The cap piece rests on two short legs, which are set on top of the coal in places cut out of the roof shale. In some cases, where the roof is very bad, these sets are lagged. These short leg sets are more economical than the long leg sets as the entry can be made of smaller width, and a saving can be made in the amount of timber used. Both of these facts are important, as it is necessary to have the entries as narrow as possible on account of the bad roof, and the increase in the already enormous amount of timber is great when the long leg sets are used.

The timbers are untreated, with the exception that the large timbers are peeled and dried. The life of the timbers varies, the timbering on the intake air courses lasting from one to three years, and that on the return airways from six months to twelve months. This difference is due to the warm, moist condition of the return airways, which promotes fungus growth and decay.

The room timbering consists of ordinary room props and cap pieces. These timbers will average 5 inches in diameter, and are mostly round props, although split props are used to some extent. The room props have a life of about 18 months. Very few props are recovered when the room is finished, and in many cases are in good condition at that time.

MINING AT THE FACE. The mining here is all hand mining, or rather is called such to distinguish it from machine mining, as with the exception of the work on the entries, where the coal is sheared, the work can hardly be called hand mining, the coal in the rooms being blasted from the solid. The sulphur band near the bottom of the coal probably would be a serious obstacle to the use of machines, but their use has never been attempted.
FIG. 5. PORTION OF TIMBERING ON MAIN SOUTH ENTRY.
A typical plan of the blasting method used in the rooms is shown in Fig. 6. The miner generally drills two holes, although three are sometimes drilled. Very seldom are four holes required. The plan is to keep the face of the room irregular, as shown, so that the shots will be as free as possible. The holes have a diameter of 2 1-4 inches, and a variable length, five feet being about the maximum. The usual charge of powder is two or three pounds, with the smaller charge predominating. The fact that such small charges are used is due to two facts, (1) the coal is fairly free shooting, and (2) the excellent manner of placing the shots. Windy and blownout shots are of rare occurrence in this mine.

The blasting method used in the entries is a little more complicated than that used in the rooms. A sketch showing the method is given in Fig. 6. The coal in the entries cannot be blasted from the solid, as a free face could not be secured on account of the narrowness of the entries, and also it would be practically impossible to keep the entries straight and of regular width if solid shooting was practiced.

The coal is sheared, as shown, to a depth about equal to the thickness of the bed. The width of this cutting varies, but will be about eighteen inches at the front, tapering to about seven inches at the back. This cutting, with the face of the coal, gives two free faces. Three holes are now drilled, a center or buster shot, a lifter shot, and a side shot, as shown. These holes are of the same diameter and about the same depth as the holes in the rooms, this latter depending on the depth of the cutting.

All the blasting is done with Dupont FF powder. The charge is tamped with fireclay from the bottom, a copper tipped
FIG. 6.

"a" GENERAL PLAN OF PLACING SHOTS IN ROOMS.

"b" PLAN OF PLACING SHOTS IN ENTRIES.
tamping bar being used. The shots are fired entirely by fuses. Owing to the small size of the charges, shot firers are hardly needed under the law, as the general charge is not over two pounds of powder. By agreement, however, shot firers are employed, there being two in the mine, each man shooting about 75 rooms and entries, making a total of about 150 shots.

Very little pillar drawing is done here.

ACCIDENTS. There have been very few accidents of any importance in this mine. There have been only two fatalities, and only nine non-fatal accidents which incapacitated their victims for more than thirty days. There have been about twenty-five accidents, two of them fatal, due to falls of roof. The fact that such accidents have been few is due to two causes, one being the weak nature of the roof. As the roof is known to be bad, the miners are more careful than in mines where the roof is generally good. Timbering is carefully done, and careful watch kept on the roof in order to lessen chances for accidents. The second cause for scarcity of accidents is the freedom from windy and blownout shots. This is due to the careful drilling and loading of the holes.

HAULAGE. The loaded cars are gathered from the rooms by mules, and hauled to the main parting or latch on the main west entry. Here the trips are made up and hauled out to the shaft bottom by a tail rope haulage system. The number of cars in the trips will run from 25 to 45. The rope haulage runs from the engine room near the shaft bottom down the main south entry to the mouth of the main west entry, and west along this to the main parting, a total distance of about 4500 feet. The power for haulage is furnished by two second motion 12" x 20" engines, driving two drums upon which the main rope
and tail rope wind. The tail rope drum has a diameter of about 4 1-2 feet, and the main rope drum a diameter of about 3 1-2 feet. A haulage indicator is used to show the position of the trips on the entries. This consists of a nut traveling on a horizontal screw shaft, which is rotated by means of bevel gears, which are chain driven from the tail drum. The indicator is driven from this drum on account of the trips being cut in the workings.

The tail rope, which is a 1-2 inch regular lay rope, is carried by rollers and sheave wheels along the roof of the entries to a short distance beyond the main parting, where it passes over two small wheels (diameter about two and three feet), which take the place of one large wheel. After passing over these wheels, the rope runs over floor rollers, and is attached to the rear end of a loaded trip, and pulled out to the shaft bottom by the main rope, which hauls out the loaded trip. To take the empty cars back into the workings, the tail rope is attached to the front of a trip and pulls it in, while the main rope is attached to the rear of the trip and dragged in just as the tail rope was dragged out. The main rope runs along the track rollers and sheaves altogether. The track rollers are placed generally at intervals of 17 and 19 feet, the average distance being about 18 feet.

As before stated, the loaded cars are caged on both cages from one track, by means of a switch at the shaft bottom. The empty cars on the cages are bumped off by the loads, and run down a three per cent incline to a car lift. This is an automatic device for handling the empty cars, and is shown in Fig. 8. The car runs onto the tracks of the car lift, and strikes the forward lever, thus opening a valve which admits steam to the cylinder. By means
FIG. 8
CAR LIFT USED AT ELECTRIC MINE.
of wire ropes passing over the sheaves at the top of the lift frame, the piston in the cylinder at once moves down, and raises the free end of the pivoted section of track so that it has a 10 per cent grade in favor of the car. As the car leaves this part of the track, it strikes another lever which opens the exhaust valve on the cylinder, and thus lets the pivoted track drop down to its normal position. The car, with the impetus it has received goes down over a short section of 2 1/2 per cent grade, then over a short level track, and up a 5 per cent grade or kick-back, where it comes to a stop and starts to run back toward the shaft. In the short level referred to, however, is an automatic switch which shunts the car into the run around on the east side of the shaft. This run around has a grade of 1 1/2 per cent, and a length sufficient to accommodate 65 cars. This length is so great that without the extra height given by the car lift, the momentum of the car would not be great enough to carry it to the end of the run around. The car lift thus allows a longer run around to be made, which prevents congestion at the bottom, and also eliminates the trouble of going back into the run around with the tail rope to bring the cars out.

The number of men used in the haulage system is few, due to the simplicity of the arrangement. From the parting to the tipple, only four men are used, these being the haulage engine-man, the trip rider, cager, or bottom man, and one other man at the bottom to look after cars and to assist the cager. This number is as small as it could be as even with an automatic caging device a man would be needed at the bottom to act as signal man, and the other men could not be dispensed with.

The tracks in this mine are all of three foot gauge.
teen pound rails are used in the entries and wooden room rails are used in the rooms. Considerable trouble is experienced with the mine bottom, which heaves considerably. Oak ties are used, and are spaced about two feet apart. The cars are wooden, with a hinged door, and have a capacity of about 1 1/4 tons.

DRAINAGE. Drainage is quite a problem in this mine, owing to the water in the sand beds above the coal. As before stated, the water from the shafts is carried to a sump and pumped out. A steam pump is used for this particular sump, and handles probably somewhat less than half the water pumped out. The pump room has an arched concrete roof, and is one of the few places in the mine where timber is not used. At the main parting there is an electric pump driven by a 7 1/2 H.P. motor, and another pump also driven by a 7 1/2 H.P. motor is located at the old parting on the main south entry. These three pumps together handle about 1200 tons of water each day. The water breaks through into the rooms in many cases, and considerable of the water which is being pumped out at the present time comes from the old mine which was broken into recently. The water is very acid, and the pipes in the sumps have to be replaced every two months.

VENTILATION. The ventilating power is furnished by a 16 foot Crawford and McCrimmon blowing fan. This furnishes about 50,000 cubic feet of air per minute, at 200 R.P.M., which is more than required by law for the 200-odd men and 20 mules in the mine. The air travels through the mine in three splits, two splits for the workings, and a minor split for the stables. This last exhausts up the hoisting shaft. The upcast shaft between the 12th and 13th south entries is 8'x6' in size, and is fitted with a lad-
TYPE OF SHAKING SCREENS USED AT ELECTRIC MINE.
der for use as an escapement shaft. This gives the mine two escapement shafts, the downcast air shaft being the other. There is no gas in the mine, and in general the ventilation is very good. Crosscuts between main entries are stopped with a 6 inch concrete stopping, thus reducing the leakage of air in the main entries to a minimum. On the cross entries rock stoppings are built.

LIGHTING. The main entries are lighted by incandescent lamps, set at varying distances averaging about 200 feet apart. The miners use oil and carbide lamps.

PREPARATION OF THE COAL. The preparation of the coal is begun in the mine, where the miner rejects all pyrite and shale of large size. To insure against the loading of impurities, an inspector or dock boss is employed. Employes found loading shale or pyrite are fined fifty cents for the first offense and $2.00 for the second offense. Half of the money from fines is paid to the miner's union, and the other half to the company. Another preventive of dirty coal is the fact that the miners are paid 75 cents per car for pyrite.

Sizing of the coal is effected by shaking screens. The coal is dumped at the tipple into the weigh-hopper, thence discharged upon the shaking screens. These have a length (total) of 26 1-2 feet and a width of 7 feet. By changing the plates, any different sizes of coal can be made by these screens, but at present the sizes being made are slack, which passes through the 5-8 inch holes, in the first screen; nut, which passes over the 5-8 inch holes and through the 1 1-4 inch holes in the second screen; and lump, which passes over the 1 1-4 inch boles. About 60 per cent of the coal shipped is lump coal. The small size, slack, or screenings, has a good market.

The plant for the preparation of pyrite is distinct from the
VIEW OF PLANT, SHOWING PYRITE PLANT AT LEFT.

PYRITE PLANT.
coal tipple, and handles about 20 to 25 tons of cleaned pyrite per
day. A flow sheet of the pyrite plant is shown. The chunks of
pyrite and coal are brought from the mine, or shipped from neighbor-
ing mines, and fed into the jaw crusher. From the crusher the pie-
ces fall into the buckets of the elevator, and are carried up into
the crushed material bin. From this the pieces are fed into the
cleaner, which is a hollow rotating drum, similar to a Bradford
breaker, or to a foundry rattler. In this cleaner, the particles
of coal adhering to the pyrite are worn off, and fall through the
cracks of the rattler onto a belt conveyor. The cleaner is stopped
to allow the cleansed pyrite to be removed, and this runs down a chute
to another bucket elevator which elevates it to the storage bin
over the tracks. From this bin the pyrite is loaded into cars for
shipment. The coal which falls onto the belt conveyor is carried
up and discharged at the end of the conveyor into cars. The pyrite
cleaned is used in the manufacture of sulphuric acid.

DISPOSITION OF PRODUCT. About half of the coal produced
is sold to the Chicago, Cleveland, Cincinnati, and St. Louis, or
"Big Four" Railroad. The remainder, with the exception of the
amount used at the mine, and sold the miners, is shipped to Chicago,
Ill., Indianapolis, Veedersburg, Crawfordsville, and intermediate
points in Indiana, and at Champaign-Urbana, Illinois, and intermed-
iate points. Considerable is sold to local trade at Danville, and
at points adjacent to the mine, Hillery, Oakwood, etc.
TIPPLE, COAL BINS AND LOADING TRACKS. TIMBER YARD IN BACKGROUND.
Freight rates are as follows:

On C. C. C. and St. L. (Big Four).

To Chicago, 128 miles, $0.74
" Indianapolis, 88 " 0.50
" Veedersburg, 24 " 0.40
" Crawfordsville, 48 " 0.40
" Champaign, 30 " 0.40
" Soldier's Home at Danville, 0.25
" Danville, 3 miles, 0.15

On C. and E. I. R.R.

To Soldier's Home at Danville, 0.25

On Illinois Traction System.

To Champaign, 33 miles, 0.40

SURFACE PLANT. The power plant consists of boiler and engine room, the latter containing also an electric generator. The engine and boiler rooms are combined in one building 40 feet by 80 feet, built of brick and roofed with corrugated steel. The front of the boiler room is also enclosed by corrugated steel. The roof is supported by wooden trusses spaced 12 feet center to center in the boiler room, which occupies 50 feet of the building. The engine room has one truss in the center of the room.

The equipment of the power plant consists of three sets of Atlas tubular boilers, which were installed at a cost of $1500 per set; a pair of direct acting Danville hoisting engines, 16 inch by 32 inch cylinders; an Armington and Sims 12 inch by 12 inch en-
gine driving a 22 l-2 K. W. generator. The hoisting engine drives a 5 foot cylindrical drum, and is equipped with a band brake and steam power reverse. The generator delivers a current of 90 amperes at 250 volts, and drives three motors, two under ground at the pumps and one in the pyrite plant. The cost of the generator was $650, and with the engine $1200.

Besides the power equipment, the power house is supplied with fire extinguishers, telephones, and compressed air gong for signalling.

Other engines on the surface are the shaker screen engine, of 20 H.P., which cost $350.; the fan engine, which cost $1000, and an engine for pulling empty cars down under the tipple. This cost $275.00 and drives a drum upon which a wire rope is wound. This rope passes around a sheave wheel, then up past the tipple to the empty tracks, where it can be attached to an empty car.

The blacksmith shop is a small brick building, fitted with the usual blacksmith shop equipment. Its cost was $700.

The powder house is located about 150 feet east of the tipple, is built of brick, and has a capacity of about 800 kegs of powder.

There are eight small wash houses at this mine, two being double and six single. These are all frame structures, are fitted with electric lights and steam heat, and can accommodate about 100 men. About 60 men are using them at the present time. The superintendent's office near the wash-houses, is a small frame structure of two rooms.

The headframe is of the square type, with one inclined leg, and is built of wood. The tipple structure is also of wood.
TYPE OF CAGE USED AT ELECTRIC MINE.
and contains the shaking screens, chutes, weigh hopper, and weigh office. The weigh office is equipped with a Fairbanks-Morse scale for weighing the coal.

The hoisting cages are of the self-dumping type shown in the figure. They are equipped with safety catches operated by springs.

The tipple and headframe were built by the company, as were the coal bins adjacent to the tipple. These have a capacity of 50 tons each, a total of 100 tons. The coal is elevated into these bins by a bucket elevator, which has a capacity of 100 tons per day. This is driven by a 12 H.P. engine. The cost of the combined tipple and headframe was $3000, and the cost of the bins $5000.

The surface tracks belonging to the Big Four Railroad have a total length of 3840 feet. The tracks for empty cars above the tipple are 2240 feet long, and have a capacity of about 50 cars. The loaded tracks will accommodate about 40 cars. Track scales are under the tipple, and consist of one Fairbanks-Morse, and one United States track scale.

The water used by the company is obtained from the pond adjacent to the mine. This water is of good quality, and the supply is plentiful. The cost to the company is $60 per year, paid as pond rent.

Surface lighting is by electricity, and the power is furnished by the generator in the engine room.

STATISTICS. The capacity of this mine is 1500 tons per day, but at the present time only about 900 tons are being hoisted. The total number of workmen, and the number in each class, is shown, the figures being averages, from the 1911 Coal Report:
Cages, 3
Drivers, 11
Laborers, 36
Miners, 216
Shot firers, 4
Timbermen, 14
Trackmen, 8
Trappers, 6
Not classified 34
Total, 332

There are 20 mules in the mine, and one on the surface.

Prices paid for labor, agreed upon by miners and operators, for the two years beginning April 1, 1912:

Miners, 0.61 per ton.
Entry men, 6 ft. entry, 1.08 " ".
" " 7 " " 1.01 " "

Where cross bars are required in the entries, they may be set by the timbermen, or the entrymen. When entrymen are required to set cross-bars, the price is 38.3 cents for each bar, and where it has been the practice to pay an additional price per ton of coal to the entrymen for setting bars, the addition is 7 3-4 cents per ton. The price for setting neck bars is 76 cents per bar.

Where miners are required to drive through rolls, the wage per day is $3.00
Day labor prices are as follows:

Trappers, 1.25
Car greasers, 1.56
Track layers, 2.84
Track layer's helpers, 2.62
Timbermen, 2.84
Timbermen's helpers, 2.62
Cagers, 2.84
Drivers, haulage engineman, 2.84
Trip Riders, 2.84
Water haulers, 2.84
Pipemen, 2.78
All other bottom labor, 2.62

Outside labor:

Engineer, 1st man, $100.00 per month.
  " 2nd " 88.87 " "
  " 3rd " 83.27 " "
Firemen, 2.62 per day.
Blacksmith, 3.38 " "
Car repairers, 2.62 " "
Carpenters, 3.00 " "
Weighmen, 2.84 " "
Other outside men, 2.30 " "
The cost per ton of coal for the months of March and February, 1912, is shown:

<table>
<thead>
<tr>
<th></th>
<th>February</th>
<th>March</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining</td>
<td>$0.6560</td>
<td>$0.6640</td>
</tr>
<tr>
<td>Sup't; Engine room</td>
<td>0.0285</td>
<td>0.0834</td>
</tr>
<tr>
<td>Nightmen</td>
<td>0.0504</td>
<td>0.0577</td>
</tr>
<tr>
<td>Drivers</td>
<td>0.0432</td>
<td>0.0414</td>
</tr>
<tr>
<td>Haulage</td>
<td>0.0214</td>
<td>0.0196</td>
</tr>
<tr>
<td>Trappers and greasers</td>
<td>0.0128</td>
<td>0.0132</td>
</tr>
<tr>
<td>Bottom and track men</td>
<td>0.0229</td>
<td>0.0289</td>
</tr>
<tr>
<td>Top men</td>
<td>0.0258</td>
<td>0.0268</td>
</tr>
<tr>
<td>Dead work</td>
<td>0.0657</td>
<td>0.0622</td>
</tr>
<tr>
<td>Chutes</td>
<td>0.0029</td>
<td>0.0038</td>
</tr>
<tr>
<td>Bars</td>
<td>0.0041</td>
<td>0.0036</td>
</tr>
<tr>
<td>Office</td>
<td>0.0076</td>
<td>0.0232</td>
</tr>
<tr>
<td>Timber</td>
<td>0.0550</td>
<td>0.0550</td>
</tr>
<tr>
<td>Smithing</td>
<td>0.0015</td>
<td>0.0026</td>
</tr>
<tr>
<td>Supplies</td>
<td>0.0210</td>
<td>0.0373</td>
</tr>
<tr>
<td>Accrued Tax and</td>
<td>0.0200</td>
<td>0.0158</td>
</tr>
<tr>
<td>Insurance</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1.07</strong></td>
<td><strong>1.10</strong></td>
</tr>
</tbody>
</table>
The value of the plant is as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery, excluding fan</td>
<td>$12,275</td>
</tr>
<tr>
<td>Mine cars</td>
<td>$8,050</td>
</tr>
<tr>
<td>Tipple and bins</td>
<td>$8,000</td>
</tr>
<tr>
<td>Other surface buildings</td>
<td>$3,000</td>
</tr>
<tr>
<td>Timber</td>
<td>$1,200</td>
</tr>
<tr>
<td>Live stock</td>
<td>$2,100</td>
</tr>
<tr>
<td>Other items</td>
<td>$33,000</td>
</tr>
</tbody>
</table>

Total amount expended on plant: $67,633
Depreciation: $29,242

Present value of equipment: $38,391
Farm land: $13,975

Figuring on a basis of 1,750 tons per foot per acre, the amount of coal originally in the property was 3,160,625 tons. Of this, 1,156,277 tons have been mined, a percentage of 37.6, leaving 2,004,348 tons in the property. Of this, probably 1,750,000 tons cannot be mined, being left as pillars. Assuming a value of 5 cents per ton for the remainder, the value of the coal is $12,715.15

Adding this to the value of equipment and land, the total value of the plant is $65,083.00

**Recommendations.** Owing to the fact that the mine is so nearly worked out, recommendations as to method of working, etc., are considered unnecessary. Practically the only recommendation is that the timber yard should be moved farther from the tipple, as
both being wooden, the danger from fire is increased by the proximity of the timber yard to the tipple.

CONCLUSION. In conclusion I wish to thank Professor H.H. Stoeck of the Department of Mining Engineering, and Mr. W. G. Harts-horn of the Electric Coal Company, for their assistance in preparation of this report.
SURFACE BUILDINGS AND TRACKS
AT THE ELECTRIC MINE
April 1915
Scale 1" = 100'
J. E. Wight