

The Knowledge Bank at The Ohio State University
Ohio Mining Journal

Title: Coal Mining in Ohio

Creators: [Roy, Andrew, 1834-](#)

Issue Date: 15-Nov-1883

Citation: Ohio Mining Journal, vol. 2, no. 1 (November 15, 1883), 3-15.

URI: <http://hdl.handle.net/1811/32442>

Appears in Collections: [Ohio Mining Journal: Volume 2, no. 1 \(November 15, 1883\)](#)

THE OHIO MINING JOURNAL.

NOVEMBER 15, 1883.

COAL MINING IN OHIO.

BY ANDREW ROY.

The beds of coal which traverse the Ohio coal field are not disturbed by dykes or dislocations of the strata, so frequently found in other coal fields of the world. There are many local faults found in our coal mines, which are known by the general name of "horsebacks." These faults, which sometimes come from the roof and sometimes from the floor of the mine, are occasionally troublesome and expensive; but taking the whole coal field throughout, the conditions for cheap and systematic mining are unusually favorable. The floor of mines is comparatively level, the usual dip, except in local cases, being 25 or 30 feet to the mile.

Over large areas of the coal field, where the country is hilly, the beds of coal in course of development come to day or crop out in the hillsides, and admit of what is termed drift or level-free mining. Under such conditions the seam is followed into the hill, and the waters of the mine discharge themselves by gravitation. Care is taken in opening a drift mine to select the lowest place on the property, if the circumstances will admit of it.

In regions where level-free mining is impracticable, two methods of sinking for coal are followed: one is by opening perpendicular shafts, and the other by sinking slopes at a pitch of from 25 to 35 degrees. Slopes are, however, rarely opened where the coal is found more than 150 feet below the surface, for below this depth it is more costly to sink and deliver coal by a slope than by a perpendicular shaft. Under favorable conditions slopes are largely a matter of taste on the part of managers; they are never cheaper than shafts.

The coal business has localized itself and the various districts in which the mines are opened are known by appropriate names.

There are now a dozen districts in the State in which the coals possess peculiarities by which they are known, as the Mahoning Valley region, the Jackson County region, the Iron-ton region, the Pomeroy region, the Bellaire region, the Steubenville region, the Salineville region, the Cambridge region, the Dell Roy region, and the Coshocton region. Sometimes two or more qualities of coal are drawn from the same bed, as, for example, the Brier Hill coal and the Mineral Ridge coal, both of which are mined in the Mahoning Valley; or the Nelsonville, Straitsville, Shawnee, Sunday Creek and Monday Creek coals, all of which are drawn from the great seam of the Hocking Valley region.

All other conditions being equal, the best seams are selected and opened. There are thousands of acres of as good coal still untouched in the coal field as in any present course of development, but for want of railroad facilities, or because of its lying in the interior of the coal field, it remains for the time being unwrought. The severe competition of the trade obliges the mining operators to take advantage of all the conditions in developing the mines. The districts which are furthest from market must have superior coals, which command extra prices, or else the trade languishes. The business largely turns on the character of the individual seams. The quality of the coal rather than its thickness, and the cost of placing the same upon the market, very largely determines the value of mining properties and mines.

All seams of coal, two feet thick and upward, are regarded as of mineable thickness, but four feet is regarded as the standard height. The expense attending the working of a three-foot vein is often considerably greater than working one four feet, exclusive of the dead work. This is a general but not universal rule, and obtains in mines like those of the Mahoning and Tuscarawas Valleys, where the coal varies suddenly in thickness. In such mines, for digging all coal below four feet, 5 cents per ton extra is paid for every 3 inches of decreasing height, until the seam falls to two feet, when it is regarded as unmineable. At Leetonia, Hammondsville, and in the Coalton district of Jackson county, coals no thicker than 28 to 32 inches are wrought, but these coals possess peculiar qualities. The best coke in the State is made at Leetonia and Hammondsville, and everything that comes from the miner's pick is credited to him. At Coalton the coal is tender, and mines very easily. The difference in expense of mining a

4-foot coal over a seam 10 feet in thickness is inconsiderable in amount; the advantages to mining operators who possess thick coals consisting more in the greater yield per acre than the lessened cost of production. Thus, at Wellston, in Jackson county, the coal is 4 feet thick; while at Straitsville the bed is 9 to 10 feet thick, but the same price obtains in both places for digging; at Wellston the coal is a homogeneous mass, while the thick coal of the Hocking Valley contains two bands of shale, and frequently a band of bone coal, which have to be sorted out by the miner, which militates considerably against his producing power.

In point of economy, drift mines do not ordinarily possess any material advantage over shaft mines opened in the same district.

It costs less, it is true, to open and equip a drift than a shaft; but after a shaft is opened and equipped the workings may be extended east, west, north and south, without any interruption to their symmetry or continuity. In drift mines on the other hand, even under the most favorable circumstances, not more than one-half of the same extent of work can be opened up; and, frequently, by means of the numerous ravines, which cut down through the coal, a symmetrical and extended mine cannot be laid out at all. Moreover, a considerable part of hill coal along its line of outcrop is so largely impregnated with iron rust and earthy matter, as to render it unfit for market. In deep shaft mines, which discharge a great flow of water, the advantages are in favor of drift mining, but we have neither deep nor wet mines in Ohio.

In districts in which coal seams about to be developed are level-free, the manner of opening mines is simple and inexpensive. The coal is usually exposed at some point on the hill-side, and is readily distinguished by a dark colored streak on the clay, called the coal "blossom" or "outcrop." As the blossom is followed into the hill it gradually hardens into coal. For some yards, sometimes for many yards, the coal is soft, dead and rusty. This is called crop coal, and cannot be shipped. If the front of the hill in which the mine is opened is bold and steep, the coal soon becomes compact and bright, and fit for commercial use; but if the hill is retreating, and the mine is opened near the top, the entries may be pushed from 50 to 100 yards before merchantable coal is met. On lands where the cover is light, say 30 or 40 feet, and is mainly composed of alluvial matter, only a few feet of shale forming the immediate cover of the seam, the coal is often so

tender and earthy as to be worthless. Under such conditions the roof is never good.

All drift mines require to be timbered for some distance from the mouth. The timbers, which are made out of hewn or sawed wood, are usually 8 by 10 inches in size, their length being governed by the height of the seam. The bents are sometimes placed close together, but are generally set about $2\frac{1}{2}$ to 3 feet apart, the intermediate space being filled with 2 inch plank. The leg of each bent of timbers slants inward about 1 foot in 6. If the bottom of the mine is wet, cross-sills are laid under each bent to keep them from sinking.

The mine is usually made from 8 to 10 feet wide, and the timbering is carried forward until the roof becomes so firm that it will safely stand of its own accord.

The point usually selected for opening is as near the southeast line of the mining property as may be practicable, so as to extend the workings to the north and west, along the rise of the strata, to facilitate hauling and draining. For 100 to 200 feet the coal usually dips from the mouth of the opening; experienced miners take up several feet of the bottom, which they tail out to a point.

It is not always practicable to open and work to the rise of the strata. The main entries of many mines run east or south. This always adds to the cost of getting the coal, but it cannot be avoided.

When the coal lies in the hill, 25 to 30 feet above the level of the railroad switch, the most favorable conditions for opening a mine are found, as this gives the proper height for dumping the mine cars through the chutes into the railroad cars below. We have, however, to accept the conditions as we find them; and frequently a mine is opened high upon the hill. Under such circumstances an inclined plane is constructed from the chutes to the drift mouth; the track of the plane is made double, the empty train ascending as the loaded train descends.

If, in opening a mine, the coal should be found too near the base of the hill to admit of dumping height, it adds considerably to the cost of hauling, as well as militates against the producing power of the mine to pull the loaded cars up-hill, from the mine mouth to the tipple, by horse-power; under such circumstances it is cheaper in the end to provide steam-power.

When a coal bed lies below water level, and has to be sunk for, it may be reached by a slope or a shaft. A slope dips at from 25 to 30 degrees, and is preferred by many managers to a shaft, owing to the facility it affords for the ingress and egress of the miners. The expense of sinking and equipping a mine with adequate machinery is about the same in a shaft or slope until the latter exceeds 150 yards in length, when, in point of economy, the advantage is on the side of the shaft. In the Mahoning and Tuscarawas Valleys the mines opened on the lower bed of the series are generally slope opening. In all the other districts of the State the shaft seems to find favor.

The width of a slope is usually about 10 feet, and the height $5\frac{1}{2}$ to 6 feet. The hauling road or railway track is made single; a loaded train of cars, two or four in number, being first hoisted and then an empty trip lowered. Shafts are made with double hoists, a loaded car ascending in one cage while an empty car descends in the opposite cage. Shafts are rectangular in shape, and are usually 8 feet wide and 16 feet long.

In commencing to sink, whether by shaft or slope, the horse and gin are employed until solid ground is reached. If the opening be no greater than 100 feet in depth, the horse and gin is often used until coal is struck, particularly in mines in which the flow of water is not great. It is, however, true economy to erect the permanent hoisting machinery of the mine before ground is broken. This has to be done sooner or later in any event, and it costs no more to construct it one time than another, while the money saved in hoisting rocks and water goes into the pocket of the mining adventurer.

All mines have to be timbered until solid ground is reached. The manner of timbering slopes is similar to that of timbering drifts, except that the bents require to be set a little closer together. In shafts the timbers are laid as tight as possible, and in well regulated mines are made of 10-inch square timbers. In some shallow mines in the State 3-inch plank is used, but this is mistaken economy. Timbers of 8 inches are light enough under any conditions.

The cost of sinking a slope, 10 feet wide, and 6 feet high, does not ordinarily exceed \$35 per yard. A shaft 8 feet wide and 16 feet long will average in good ground \$45 to \$50 per yard. This includes the expense of timbering, the powder used in blasting,

and the raising of both rock and water. No uniform rule can, however, be laid down in such matters, the nature of the ground, the flow of water, and the provisions made in commencing operations for the success of the enterprise determine the expense. Some shafts cost more than double that of others under the same conditions, and on the same field the cost of sinking varies greatly, the result of the skill and judgment exercised in grading and directing the subterranean excavations. The machinery of shaft and slope mines consists of an engine for raising coal, a pump for lifting water, and the necessary boiler power. The size of the hoisting engine is in proportion to the depth of the shaft and the weight of the coal raised. Double engines are coming into use around coal mines. Two to four boilers, 36 to 40 feet in length, and of 36 inches diameter, are generally needed to procure the necessary steam power for lifting coal and water. The drums upon which the shaft ropes revolve are 5 to 7 feet in diameter; the pulley wheels upon the pit head-frame of shafts are made 6 or 8 feet in diameter. The hoisting ropes are $1\frac{1}{4}$ inches in diameter, and are made of iron or steel wire.

At many mines where the coal is met within 100 feet of the surface, less elaborate arrangements suffice, but it is always wisdom to have good, strong machinery, and especially to have abundant steam power. The money invested for such purposes will surely find its way back into the pocket of the owner of the mines. The hoisting arrangements of slope mines differ somewhat from those of shaft mines; in the former the track is nearly always single, and only one rope is needed, while in shafts the hoist is double. At many slopes a chain is often preferred to a wire rope, but the rope is preferable.

The pit head-frame of shaft mines is made 35 to 40 feet in height; the upper landing, where the coal is delivered, is 22 to 25 feet above the mouth of the pit, and two screens are used in sorting the coal into lump, nut and pea, as it goes from the tippie into the hoppers below.

All mines have water in them. In many drift mines, particularly in those in which the workings extend to the verge of the strata, the water is discharged by gravitation. In slopes and shafts, natural drainage is impossible, and the waters of the mine must be pumped or lifted out by steam power. A number of first-class coal pumps are in use in coal mines, Cooper's and Blake's being

generally preferred to others. The size of the pump is governed by the amount of water. Some mines discharge much more water than others, and the mines of some districts are wetter than those of others. In the Mahoning Valley more water is met with than elsewhere in the State; this is due to the open character of the coal—the joints of which serve as reservoirs. A favorite pump in this valley, and one still largely in use, is the Buffalo, which has wooden pitmen, which run down the side of the slope. One of the first things necessary after coal has been struck in a slope or shaft mine, is to sink a water lodgment or sump. This is cut in the floor of the coal, and is sunk to a depth of 8 or 10 feet, and made of sufficient diameter to hold several hours' supply of water. A number six steam pump of the Cameron, Cooper, or Blake manufacture will discharge 500 gallons of water per minute, while 200 gallons per minute is a good flow in a mine. The quantity of water in mines varies greatly; frequently two pumps are necessary, sometimes three, and in the Leadville shaft in the Mahoning Valley, six No. 6 steam Cameron pumps were unable to keep down the water, even while the shaft was going down. So great was the flow of water in this shaft that special pumps had to be manufactured expressly for the occasion, and a special shaft sunk alongside of the main shaft in order to control the water. More than 3,000 gallons per minute were pumped out of the mine. The history of this shaft is so remarkable that in the description of the Mahoning Valley district, which will be found in another part of this chapter, a brief sketch of it will be given.

There are a number of methods or systems of laying out the workings of mines in use, according to the varying conditions which are met in the several mining districts, as, for example, the thickness of the overlying strata, the character of the roof as to hardness and softness, the nature and thickness of the underlying fire-clay, the ability of the coal seam to resist pressure, etc. Suitable modifications of all the English systems are practiced, except that of long-wall. A number of mines, situated along the line of the Niles and New Lisbon Railroad were opened out on the long-wall system some years ago, with satisfactory results, but during the late panic, operations were suspended. On resuming work two or three years ago, the mining proprietors changed hands, and the new manager changed the plan to pillar and room practice.

A large amount of coal has been lost, and some valuable coal is still being lost by faulty systems of mining. The first mines opened in the State were drift workings, opened in the hills along the lines of outcrop of the coal. These hills, penetrated in all directions with ravines, generally contained only a few acres of coal, and the overlying strata were not heavy. Very light pillars sufficed to support the roof under such circumstances.

As the coal trade began to develop, and the mines became more extensive, the frail supports, which sufficed for small mines, were found inadequate for those of larger extent. The result was the falling in of the workings before they were fairly opened out. In reopening them larger pillars were left; this, however, was done grudgingly, for the larger the pillars left, the greater is the expense of getting the coal. Coal lands were, however, abundant and cheap, and the cost of opening new mines inconsiderable; hence, there was a temptation to adopt any system which would reduce the immediate cost of working to a minimum.

When shaft mining became a necessity, and the first ton of coal cost the mining adventurers ten or twelve thousand dollars, better systems were adopted from a sense of true economy, until by degrees, in all the mining districts of the State, improved systems were adopted; though there are still mines in every district very unskillfully managed.

In all our well-regulated mines the plans which generally obtain, correspond to the second system of British practice—that of working with pillars and rooms, the pillars left being of sufficient strength to maintain the incumbent strata in place as the workings advanced, and after the rooms are all finished, the pillars being in turn attacked. There are many modifications of this general system practiced in the various regions of the State.

In laying out the underground workings of mines, a plan of the proposed system of working is usually made in advance by a competent practical mining engineer. The conditions must be carefully investigated as to drainage, the nature of the roof and floor, the texture of the coal, and the weight of the overlying strata. It is not always practical to follow the letter of the plan laid down, owing to the irregularities of the floor, and to the presence of horsebacks, but the spirit of the plan may be followed to the end.

The double entry system obtains in all well-regulated mines; it consists in carrying forward two galleries in parallel lines on the

face of the coal; a pillar of coal, 3 to 6 yards in thickness, being left between the entries, which is cut through every 30 to 40 yards for air. As a new air-hole is made at the face of the heading, the outer one is closed up, and made air-tight by a wooden brattice, or otherwise, so as to force the air forward to the working face. Butt entries are opened to right and left of the main galleries; they are also made double, and are in all respects like the main galleries. Entries are made much narrower than rooms; they are generally driven 8 or 9 feet wide, for the purpose of having the roof firm and safe. The rooms from which the great bulk of the coal is got, are opened in the butt entries. Rooms are started at the same width at which the entries are worked, but they are rapidly opened out to full width, 7 to 9 yards; they are worked both north and south, in lines parallel with the main galleries of the mine. Butt entries are 160 to 200 yards apart.

The pillars or ribs left between rooms are of varying thickness, according to the nature and weight of the overlying strata; under a firm roof and a light cover, ribs 2 to 3 yards in thickness suffice; they are made thicker in proportion to the weight of the overlying rocks. Thin ribs are cut through every few yards, but when they are 4 to 6 yards in thickness, break-throughs are less frequently made. These break-throughs, like those made between the entries, are cut for the purpose of keeping a fresh stream of air as near the face of the workings as may be practicable.

The pillars of the mine are generally allowed to remain until all the rooms are worked out; they are then attacked in the interior of the mine, and cut away as clean as practicable, but a great part is necessarily lost by the falls which follow their extraction. Pillar-work is the most dangerous part of mining. In some mines the pillars are attacked as soon as the rooms are finished; under such circumstances it is necessary to leave strong supports along the galleries, to prevent the crushes and falls of the overlying rocks from overrunning the mine.

The manner of digging the coal is artful and curious. The tools of the miner consist of a sledge, 8 to 10 pounds in weight; several steel wedges, 6 to 8 inches long; 3 to 6 picks, from 2½ to 3 pounds in weight, with handles 28 to 32 inches in length; a set of drilling tools, to wit: a drill, a scraper, a needle, and a tamping bar; frequently the drill and tamping bar are made of one piece, one end being used for a drill and the other for a tamper.

Two miners work together in rooms and entries; they keep each other company, assist in setting props; one watches while the other works in dangerous situations, and if one is caught, the other can raise the alarm and call in adjoining comrades to the rescue.

The first and the most laborious part of the work of coal digging consists in undermining, or bearing in, or holing the rooms. This is generally performed in the bottom of the coal seam with the pick. An undermining is made of varying depth, sometimes 3 to 4 feet, frequently 5 or 6 feet; the miner stands upon his feet, and strikes with all his strength, until a few inches in depth are bored in; he then sits down on the floor of the mine, his legs stretched wide apart in front of his body, and cuts in 6 inches to a foot deeper; finally he stretches his body along the floor, his shoulder and arm to the elbow resting upon his thigh, and in this constrained position finishes up the undermining. It will take two active miners 4 or 5 hours to undermine a room 8 yards wide and 4 to 5 feet in depth. Forty or fifty blows of the pick are delivered per minute, and considerable skill is exercised in holing. Miners raised to the work from boyhood are both speedier and cleaner workmen than those who assume the calling after manhood. There is a good deal of difference also in the nature of the undermining, some beds cutting easy others hard. A room is not usually undercut across its whole breadth in preparing a blast, though it is better to so undercut it.

Having finished the undermining, the next thing in order is boring a hole for the blast. Some skill is also required in performing this work, so as to give the powder the best possible advantage. In some mines more reliance is placed upon the drill than upon the pick, the coal being largely blasted out of the solid. In doing so the miner shatters the coal, but this gives him little concern so long as it adds ease to his body. Coal is not mined now with the care and skill of ten and twelve years ago. The amount of powder required for a shot varies from 1 to 8 pounds, the former amount sufficing when the coal is properly undermined—the latter amount being required in blasting out of the solid. As a general rule, a pound of powder is burned for every three tons of coal mined. In the Massillon region, where the main weapon of the miner is the drill, a pound of powder is burned for every single ton mined. In some mines powder is not required, the coal being knocked down after it is undermined, with wedge and sledge.

The entries of mines are driven so narrow that prop-wood is not required to maintain the roof in place, but all rooms need propping. Sometimes 4 or 5 rows of props, planted 3 to 4 feet apart, are required to make the roof safe. The props are sunk in the floor a few inches, and are surmounted with a flat-cap, about 2 inches thick, and 10 inches wide, and 18 inches to 2 feet in length. Some mines require only one or two rows of props. The roof is not uniform throughout the mine; in one part it may be hard and strong, in other parts, tender and treacherous.

The railroad track of mines is about 3 feet in width; along the main entries the rails are made of T-iron, 12 to 16 pounds to the yard; in the rooms scantling is generally used, the size of the rail being governed by the weight of the loaded mine cars. Providing a good T-iron track all over a mine, entry and room alike, is true economy on the part of mine owners, although the first cost may be greater.

A good track and abundant ventilation are found wherever good mining engineering practice prevails. Mules cannot haul coal over bad roads; miners cannot work in bad air. Nature will rebel; the mule may be lashed by the driver, but he will retaliate with his heels; the miner may be cursed by the boss, but he will retaliate with a strike.

Mines in which the coal is 6 feet high use horses for hauling; below this height, mules are used.

Beds lower than 4 feet require to have the roof ripped, to admit the hauling with mules. In low veins, a frequent practice is to employ pushers to push the mine cars from the working faces to the hauling roads or entries. This is the practice in the Steubenville district of Jefferson County, and the Coalton district of Jackson County. It costs less to employ men as pushers than to rip the roof to admit mules.

Along the main galleries the roof is ripped from end to end, and mules do the hauling to the main shaft or mouth of the drift, as the case may be.

In the thicker beds of coal the mine cars hold 1 to 1½ tons; in the thinner veins, ½ to 1 ton. Thick beds cost less than thin ones for hauling coal, and other dead work. The cost of the dead work of mines ranges from 15 to 40 cents per ton; this includes entry-driving, cutting air-ways, cutting ditches, blasting roof and bottom, laying track, providing props and rail timber, and hauling, dumping, and loading coal.

Three grades of marketable coal are made at mines, "lump," "nut," and "pea," the latter, which is the finest or smallest variety, is not made at all mines. The space between the bars of the screen is 1 to $1\frac{1}{4}$ inches; occasionally wider or narrower bars are used, but they are exceptional cases. All coal which does not fall through the bars of the screen is called "luma." A second screen, with bars $\frac{1}{2}$ an inch apart, separates the "slack" from the "nut." Pea coal is made by screening the nut coal. The slack is raised from the ground by a self-loading elevator, and thrown into a revolving circular screen, which thoroughly sifts out the fine coal which falls back to the ground, and is hauled away as refuse matter. At some mines the nut coal is washed and purified before being loaded for shipment.

The proportion of lump to nut and slack varies considerably in mines, partly owing to the nature of the coal, and partly to the skill with which the coal is mined. Tender seams naturally make more nut and slack than hard coal. In the Coalton or Wellston district, where the seam is unusually tender, two-fifths of the whole pass through a $1\frac{1}{4}$ -inch screen, while in the Mahoning Valley, in the Brier Hill district, where the coal is hard and firm, only one-sixth of it falls through the screen. In mines in which powder is injudiciously used the coal is wantonly broken up into nut and slack. Unskilled miners make more fine coal than experienced workmen.

Work commences in the mines at 7 o'clock A. M., an hour is given to dinner at noon, and work ceases at 5 P. M.; nine working hours being a day's work. The diggers work by the ton, and are in a measure their own bosses. All the workmen are expected to be down the shaft or slope before the mules commence hauling. In mines in which heavy charges of powder are used in blasting out the coal, the workmen are forbidden from firing until 4 P. M., in 5 minutes after the signal is given 40 or 50 discharges are heard, and such is the force of these blasts that the earth shakes above. Vast volumes of smoke load the air of the mines after these subterranean discharges.

In some mines firing is allowed twice a day, at noon and quitting times, and in the Steubenville district, where small discharges of powder suffice, and the ventilating currents are unusually strong, the workmen blast at all hours of the day, and suffer no inconvenience in consequence.

All shaft mines are provided with cages or elevators, upon which the loaded and empty cars are raised and lowered through the shaft. Cages are provided with safety-catches or locks designed to hold the cage in the guides, and prevent it from falling in case the rope should break. On the top of the cage there is a cover of oak boards or sheet-iron to protect the workmen from falling stones, and in front of the shaft, at the landing on top, self-acting gates are placed, which are lifted out of the way by the ascending cage, and drop back as the cage is lowered, and guard the entrance of the shaft. Not more than ten persons at once are allowed by law to ascend or descend a shaft mine. Signaling arrangements are provided at all shafts, consisting of a bell or hammer, for the information of the hoisting engineer. When a loaded car is pushed on the cage at the bottom, the cager below raps once, signifying that coal is coming up; two raps are for the return of the cage, and three raps that men are about to be hoisted, when the engineer exercises more than ordinary care. The system of signaling is not uniform at mines, though it should be. The best signal arrangement in the State are in use at the Garfield shaft in Trumbull County. There is a bell on top and one at the bottom. When men are about to be hoisted the cager below raps three times, the engineer answers by one rap, and until this is done no person is allowed to step on the cage. After the miners, (not more than ten in number), are safely on the cage, the cager knocks again, giving one rap; the engineer answers that he is about to start by one rap, and the men are carefully raised to day.
