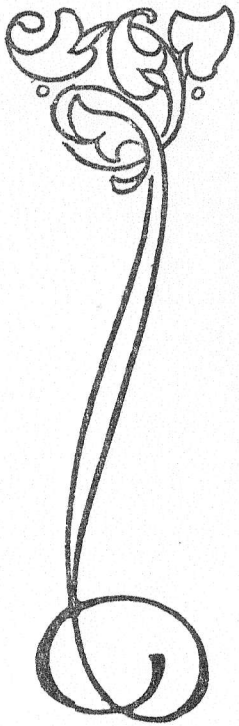
Comments of An Ore Engineer

Read by Arthur J. Mason before the American Economic Association at Atlantic City, December Twenty-eighth, Nineteen Hundred Twenty.



COMMENTS OF AN ORE ENGINEER

Read by Arthur J. Mason before the American Economic Association at Atlantic City, Dec. 28, 1920.

Just before the war circumstances took me for the most part of a year into contact with coal mines and mining.

I had passed a good many years in the steel business participating in the reform which changed the manipulation of the raw material used in steel-making from hand work to machine.

I had seen the cost of a typical unit act, such as unloading a ton of iron ore from ship, drop from 25 cents a ton to 5 cents or less.

I had watched the the slow sobering of the personnel in a plant as the introduction of machines took from the shoulders of the sons of men excessive physical work—so excessive as each night to leave a man in such a state that relaxation and entertainment could only come to him through the use of alcohol.

I had watched the process of picking out and promoting the brighter spirits in the crews to jobs calling for greater skill and thought. I had watched the stimulating and uplifting effect on groups of men as they participated in bringing about a plan to do more and better work, each one, each day.

Through such observation I have come to a firm and definite conclusion of the value of labor-saving devices to masses of hard-working men in elementary work, even though the first effect seems to be to run them out of a job.

Part of that conviction is the belief that there is no other procedure to raise the status of such groups but in labor-saving devices. Further, that the enormous economic advantages are not more important than the moral effect, which contemporaneously and naturally flow from the use of such devices.

Only through them can we lighten, sweeten and render more profitable the lives of the millions of men who now work out of sight in coal mines.

The poor Asiatic actually regards jealously a beast of burden as his competitor and rival.

We will not go very far until we remove from down in the coal mine the obsession that steam and electric beasts of burden are competitors and rivals of men's bodies—the Asiatic view—and substitute the belief that these agencies are friends and humble aids just as much as domestic animals.

We are met to study over the economics of the coal harvest. The viewpoint I am to take is that of an outsider. Not always does the onlooker see most of the game, but his view is bound to vary either from the coal operator, who is too close to the game and too interested in its habits, or the economist and statistician, whose mind dwells on the refinement of the existing order of things as set forth in recorded facts.

The ore man first realizes the radical difference surrounding the art of ore handling as a stage of steel making, from its kin the art of coal mining.

The steel business is dramatic; it has been very profitable; great fortunes, remarkable men, are associated with it in the public mind. Vast numbers of fine technically trained young men seek it. Steel plants are adjacent to large cities; the personnel participates in the life of such places. It employs all the arts, and its work is easily translated into readable journalism.

On the other hand, coal getting is essentially provincial. It is a dirty occupation; out of sight. It attracts a large number of simple-minded, vigorous men, largely of foreign birth, who from their isolated lives have small chance for what we call Americanization. This is not an unfair statement, and explains the fact that iron ore handling has gone so far—has already achieved the reform in procedure which coal mining awaits.

Low grade copper ore manipulation has already benefited by utilizing the devices and knowledge of the iron processes.

The four great opportunities in coal production and use appearing to me are:

1. Mechanical loading of the coal after the face is shot in the mine.
2. The establishment of great storage piles at points of large consumption.
3. A reform in use and distribution of coal at large cities.
4. The classification of coal from its chemical and physical characteristics in the manner that wheat or iron ore is now classified.

I will deal with these four ideas in order.

1. Mechanical loading of the coal after the face is shot in the mine.

The outsider with technical training and experience is astounded when he first comprehends the fact that nearly 700,000,000 tons of coal each year is shoveled by hand into mine cars in this country alone. It is to him as though we were to go back to spading our land in agriculture instead of plowing it. Let me try and visualize this work for you. The coal we burn in the months of January and February would fill up the whole Panama Canal. Who would contemplate that great work as a possibility with hand tools!

A million men in the United States, another million in the United Kingdom, pass their working lives down in the mine or near the pit mouth in the work of transferring coal from its long resting place into railroad cars.

Think of the crowds of New York, or Chicago, or Philadelphia, then remember that one man in 25 works in a coal mine, and actually one man in 12 in Great Britain. "Out of sight, out of mind," we say, and the terrible truth goes on and on.

Were it not for the peculiar psychology underground, were it not for the fact that this mining is dirty, and its details unknown to society, this matter would have been disposed of long ago. Give access to the mechanical ability of the nation, spread news of the need and opportunity, and the same kind of wit which dealt with the harvest will speedily and easily deal with the coal.

I do not regard this problem as mechanical so much as psychological. In view of what we now do in other forms of excavation, I do not regard the job as especially difficult.

My observation for the past forty years leads to the belief that intellectual and economic appeals, however logical, sound and fortified, make little headway unless accompanied by some moral and sentimental appeal.

Can one conceive a proposal more splendid than one to bring to the surface and the light of day 700,000 men to do some finer and better work, and to bring upward with them their families and dependents?

One cannot escape the conclusion that mechanical loading of coal is the principal change necessary to do this.

I will attempt to define this work. Here we have a section of a mine, a section through a so-called "room" in a coal mine.

A represents the vein of coal; B the car which is to convey it to the surface; C the auger holes bored in from the face which will contain explosives to loosen the coal; D the slot in the bottom made by the so-called mining machines. The preponderance of our coal is mined from veins in which a man may stand comfortably erect.

The prices the miner receives so much referred to in our daily papers, require him to bore the auger holes, furnish the explosives and pay for the cost of undercutting the coal by machine. After the explosion he must shovel the coal into cars like B. The cost of providing for the explosion, plus the cost of undercutting, amounts to about 15 cents. If the total paid miners be, as it is in Illinois, $1.04, then for the job of shoveling a ton of coal into a car the miner and his "buddie" gets not less than 89 cents.

This is the particular act the wastefulness of which I would now emphasize. If, in agriculture, the land were prepared by such a primitive process, then either wheat would be worth $15.00 a bushel or agricultural labor be paid at a rate of not more than $100.00 a year, a sum much greater than is now paid in China, where such primitive methods do prevail in agriculture.

The truth is that the mechanical genius of the nation has passed by this great opportunity unaware.

Is it just to the rest of us that this particular calling should remain so far behind? When one recalls the wonderful things done by labor-saving devices in the mighty aggregate effort of this nation each year, no sensible, reasonably qualified mind can doubt but that this work of shoveling can and will be done for a fifth of its present cost by machine, and, at the same time, everybody's job be lighter, pleasanter and more profitable, precisely as such has been the case with the changes in handling iron ore.

Furthermore, the work of boring the auger holes and loading them with explosives will be better done by experts who do nothing else, just as the undercutting has already been relegated to experts in whose hands the undercutting machines now do this work, far, far cheaper and less wastefully than the old-fashioned miner, wielding a short sharp pick, could ever do it.

Let me state here that when you hear of machine mining of coal, it only refers to coal under which the slot D in my diagram has been made by machine. The expression "machine mined" is misleading. It is true that machines are available to do the major operation, but so far, they don't do 1-10th of 1 per cent of the loading, and their extensive use is always threatened by the natural mistrust engendered by an old-world mental attitude prevailing in the rooms of our coal mines.

I am about to state a most glorious fact, not much known, yet which often cheers the little groups of choice spirits in each art who have brought about the wonderful labor-saving devices at the bottom of our national success.

That fact is that whenever we start up some bold and economical change in our work, we almost invariably find collateral, incidental

and unsuspected benefits as great as those we first had in mind. I will name a typical one out of a mass.

When we undertook to handle iron ore mechanically, the great comprehensive tools brought forth enabled the ore to be piled in such masses *that we abolished winter.*

Two days ago, some of us with our children and grandchildren danced round the Christmas tree, an age-long practice. Twenty years ago at such a moment hundreds, nay thousands, of men were out in the night, maybe 20° below zero, with a gale blowing, each man with his barrow or buggy, his pick and shovel, attacking frozen ore piles from the outside. You all have imagination enough to fill in the details of the situation.

Today one man does the work of hundreds. He sits down, he wears gloves, he has abundant light. He keeps the temperature of his trolley cab as comfortable as in your library. He uses the frozen crust of the pile as a protecting wall, so that like potatoes in a cellar, the ore remains in a good working condition, not frozen.

I will pass to contemplation of the collateral benefits necessarily flowing out of a system of complete mechanical mining of coal.

Roughly speaking, one may justly say that the operating cost of putting a ton of coal on a railroad car is twice the sum paid the miner. The half not paid him forms the cost of creating and maintaining in the mine, local transportation, ventilation, drainage, light, search and safety, management, lifting coal to the surface, and general maintenance.

Now this whole group of costs varies directly with the underground area from which the coal is gathered.

For my present purpose it is a fair assumption to state that for each 1,000 tons brought up, 100 acres below is provided with a labyrinth of entries, rooms, tracks, switches, ventilation devices, so that in a big mine, raising 5,000 tons, almost a section or mile square is so organized—a city underground, which utterly bewilders the novice on first acquaintance.

This area largely arises from the pseudo ownership which every miner acquires of his room or rooms, technically known as his *place.*

This place he inhabits with his "buddie" and owns for perhaps a year. An unwritten charter has for a century given him rights which are sacred. He works, or does not work, like the rest of us, according to our health, our wife's health, our national holidays, our interest in baseball, our funerals, our marriages, our quarrels. The problem of supplying empties or taking away loads from the rooms or places, thus becomes a sort of game of chess, almost impossible of proper organization.

From this the miner himself suffers most of all.

It is trite to say that progress at any point in a coal mine, like any tunnel, will proceed with the frequency with which a face is shot. I find that the room faces are shot in Southern Illinois on an average about once in four days. If these faces were shot every day, it must surely follow that the area kept alive with all the agencies I have mentioned will be cut down correspondingly. That is to say, two and one-half acres become the equal of ten acres, and the cost of mining over what is paid the so-called miner will fall in much that measure.

Machine loading will necessarily abolish the institution of places in coal mining. A group of six men with loading machine and gathering motor should average 100 tons of coal per hour loaded in mine cars and delivered to the general transportation system of the mine. This crew will proceed from room to room, with much the same sort of order that we follow in other work of a kindred character above ground.

Machine loading will enormously concentrate the work. Inasmuch as there will always be a gathering locomotive in attendance, there will be hardly any limitation to the size of mine cars. They should rise to ten, or even fifteen tons, instead of two or three or four as a present average.

Throughout the procedure everyone will think and act in larger units, and this is no small matter. Ten years ago in an earnest inquiry I could find no reason, nor could any of my expert friends on the ground find any, for the fact that coal in London, 250 miles by water route from two great coal fields, was $3.70 per ton F.O.B. cars, while coal in Chicago, 300 miles by rail, plus a terrible winter, was $2.30 F.O.B. cars, wages in Illinois being almost three times wages in

England. No other reason, I say, but thinking and acting in our case in larger units. The Englishman did his work in what I can find no other fitting expression for but a piddling way. His mine cars like baby carriages, his railroad cars hardly bigger than our delivery trucks. No one could pretend that English miners are inferior to our miners as miners. When they come here they hold their own. Yet they get but 250 tons per year against our 600 tons. Our surprise at this is only heightened when we find that the miner of the Steel Corporation doubles this figure again, and gets twice as much coal as the miner outside the Steel Corporation. There seems no limit to what a man can do when properly fortified by organization and tools.

Having prognosticated certain things twenty years ago with success, I will go into the game again and prophesy that coal production cost at the pit mouth will fall two or three-fold within the coming ten to twenty years, and yield more profit to all concerned than ever before, excepting of course our last three years' spree.

The greatest economical waste in the coal situation is the waste of manhood, waste both physical and intellectual. Most of our miners come from a European environment, cruelly hard, and lacking in opportunity. Life in the mine and a home in the vicinity do not afford what all good men most desire, an opportunity for prompt Americanization. Being isolated groups, often nationally coherent, forces are very strong to preserve the old world mentality and habits.

This situation is aggravated by the fact that coal mining has been allowed to become a seasonal industry, due to our severe climate and its caprices, my second great opportunity.

From the beginning our ore industry stopped each year with the freezing of the Great Lakes. We were forced to introduce storage systems, and out of them has developed a most astonishing group of effective mechanisms, which are ready to the hand of those manipulating coal.

The intermittent character of bituminous coal mining is very demoralizing. I wonder how many men in this room would retain their equanimity did they live under circumstances wherein day after day, week after week, year after year, they could not forecast from day to day when they would work, how much they could work, bread and butter requiring that they *must* work.

Our soft coal mines have not probably averaged 200 days' work in the year. The difficulty has always been—what 200 days; no one could tell a week ahead.

The obvious remedy for this is the storage pile at centers of consumption.

It is interesting to know that this system has long been in existence in dealing with the coal for our Northwest.

Many millions of tons are carried annually by the returning ore vessels to Duluth and other points, and from there distributed as the demand arises. This coal has been carried a thousand miles for the past twenty years for something between thirty and fifty cents a ton—an economical achievement without parallel.

Northwest practice has fairly abolished the bugbears of deterioration and of spontaneous combustion, save in very high sulphur coal.

The devices are available now in the car dump and the great storage bridge to put soft coal into stock, and take it out of stock, for something like a total of ten or fifteen cents a ton.

The creation of a system of storage and equipment will give continuity to coal mining, but its collateral advantages will be even greater. No longer will railroad cars choke the great yards at division points, demoralizing prices and stopping traffic.

The railroad will run its regular trains throughout the year to move the coal. No longer will the coal supply in our cities have its chills and fever as the weather varies.

The severe winter storm not only suddenly causes a great demand for coal, it also brings conditions under which even a normal demand cannot be met.

It is an open secret that 4-10 cents tariff per ton mile never was, or will be, a profitable figure for railroad transportation in our severe winter. There is every prospect that it will be profitable as a steady volume of business during the fine weather part of the year. Moreover, a good deal of this ultra coal movement is contemporaneous with the transfer of the harvest. It is altogether desirable that these two maximum streams of transportation should be separated in season if we can do it.

I come to my third item: A reform in the use and distribution of coal in cities.

We use about the same amount of coal per capita as England, say six tons each per annum. In our case a large modicum is used to meet a severe climate, that is, keep our bodies warm and commodities from injury; in short to promote comfort.

All of this fuel is very wastefully used. It is a safe statement to say it is burnt at a rate corresponding to six or more pounds per horsepower hour, whereas it might be burnt in large installations at two pounds per horsepower hour to effect the same result. This fuel is distributed to thousands and thousands of destinations by wheel vehicles along the streets, wearing out pavements and interfering with the traffic. In the same manner the ashes and partly burnt coal, amounting to one-eighth in weight, probably one-fourth in volume, are gathered and finally disposed of.

Needed space in buildings is occupied—those "bete noir" of housekeepers, the furnace man and the ash man, all take their place in this chain of waste and annoyance.

The primary saving which would ensue should municipalities undertake to furnish heat to the citizens, as they now do water, by means of great central stations, would reach a sum measurably equal to the present total taxation in those cities.

The secondary saving, due to the absence of smoke, the prolonged life of carpets, wall paper, clothing, furniture, curtains, laundrying, paint and a thousand directions, would, if justly stated, reach such a mighty sum as even to attract the notice and respect of one of our industrial boards in Washington during the late war.

A man in a city should no more be allowed to light a soft coal fire in his house than he is allowed to maintain a private water supply in his back yard in the form of a shallow well.

The fourth major reform which the steel business suggests is the classification of coal from its physical and chemical characteristics.

Twenty-five years ago there were perhaps 100 different varieties of iron ore on the Messabe range, each ore bearing the name of the mine—fondly supposed by the owner to have special merits.

The Steel Corporation classified all this ore into five grades or groups. This act has enormously simplified the movement of fifty million tons.

In the same way, our wheat loses its identity the moment it appears at a railroad. It then merely becomes so many bushels of No. 1 Red or some other grade. It would be impossible to move our harvest if the identity of each parcel of grain were preserved.

The benefits which would accrue from a systematization of this character in coal would be very great, and ramify in many directions. Let me pick out one.

The bulk of our coal in cities is delivered to team tracks and shoveled from the cars into wagons or trucks. I know of land in Chicago worth a half million dollars an acre devoted to such a purpose—a most wasteful use of car time, team time, and land time.

All this coal should at once be classified by disinterested officials, be mechanically unloaded by car dumps, elevated into great structures like grain elevators, and loaded by gravity into wheeled vehicles for distribution. The cost, by such a plan, would be an infinitively small part of the present cost, a vast amount of tonnage would be handled on a small area, and the railroad equipment released in a few hours instead of days.

Twenty-five years ago an empty car arriving at a Lake Erie port was some four days before it departed as a weighed load for Pittsburg. Today it is not a tenth of that time at good harbors.

Perhaps you will visualize the saving of space when I state that a metropolitan elevator will store the grain contained in a train of railroad cars six miles long.

The classification of coal according to its genuine contents will protect the public in the same manner that statutes of our States protect farmers regarding fertilizers, throwing out of the game much bunk, clarifying the business and benefiting both producer and ultimate consumer.

Today we are able on a dock front 600 feet long to do a volume of business in iron ore of over three million tons. Twenty-five years

ago it took a frontage of a mile to handle half as much. The treatment of coal in cities is susceptible of improvement of the same order.

I have deliberately kept to the last two things, which it seems must inevitably arise in coal mining when mechanical loading of coal becomes general, both due to the celerity with which a given area will be attacked and the coal robbed. The first one is its effect on safety in coal mining.

The public mind is, from time to time, aroused over the story of some great calamity. It sees pictures in the newspapers showing hundreds of women, with shawls over their heads, waiting for the bodies of their beloved to come to the surface.

Not at such times, statistics show us, do the fatalities arise. The preponderance of fatal accidents come from pieces of roof falling, not extensive, a few hundred pounds at a time.

Now every engineer knows that caving, whether in open cut or underground, is but a question of time—ground which is quite safe for a week is utterly unsafe in a month. It is plain to me that nearly all fatalities from local roof falling will disappear with complete machine mining.

It is not uncommon to leave coal in the roof merely to strengthen it. I know of mines in Illinois where as much as 20% of the coal is not taken out for this reason: to-wit, the roof is not safe for a year without it, but if the same roof was only called on to stand a month, it generally would be safe without the reinforcement of two feet of coal left in place.

The second great collateral advantage I confidently predict as a consequence of rapid machine loading will come from the fact that almost all our bituminous coals may then be taken out by the long wall system, thus winning all the coal, not the dubious 70% we now flatter ourselves with. If this be so, it means a beneficent revolution in all the stages of coal mining. For one thing, the long wall will abolish the dangerous and expensive robbing of pillars in all systems of stall and pillar mining, under which the most of our coal is won.

I find myself so often referring in the steel business to twenty-five years ago. This was the moment when the metallurgical side of the

business had so far progressed that the technical groups turned their minds to the perfection of mechanical procedure. It is only just to say that the formation of the Steel Corporation, bringing together large numbers of highly-trained young men in friendly relation, who stimulated, aided, yet competed with each other, has perhaps been the largest factor in bringing about this burst of enthusiastic effort with its grand results to all of us.

The coal business is ripe for changes along the lines indicated in the same spirit—perhaps, too, the moment is opportune. Sadly we must admit we seem to be at the portals of a period of depression. Is this not the very moment to establish in our cities, on our railroads and in our mines the agencies for production to adequately meet the next wave of prosperity and demand? Indeed, will not such a programme accelerate the coming of that happy time?

I apologize for being so technical before this audience. For the reasons I have attempted to give, an appeal must be made to the enlightened public, for the art of coal mining is out of sight and has not the advantage of all the other arts of being in the light of day and within the purview of the man who runs and reads.

Public opinion must be roused to the splendid job of bringing to the surface about three-quarters of a million vigorous men.

I repeat, I will not make much progress by a merely intellectual appeal. The appeal must have its moral, sentimental side.

It is not an extravagant statement to say that the environment and the life in the mine, under which this million men work, is less agreeable than the environment we provide in our prisons for criminals. No fair man can go into a mine without warming to the good, vigorous fellows he rubs against. Perhaps I am over-sensitive. Perhaps I feel, stronger than other men, a hatred of seeing human fingers and human muscle doing things that an inanimate machine can do better.