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Fighting the Fire at the Homestake Mine

Men Fought the Fire with Hose at First; Then Smothering the Fire with Steam Was Attempted; Finally Flooding Became Necessary

BY BRUCE C. YATES*

The orebody of the Homestake mine may be likened to an enormous chimney. Near the surface this chimney is very irregular, for a plan of any of the upper levels shows many large "fingers" branching out from the main body. To some extent this is also true of the lower levels. These fingers extend much further from the main body on some levels than on others, which fact makes the sill-floors vary greatly in outline on the different levels; sometimes this gives a mistaken idea as to the amount of ore between any two levels. The slate foot and hanging walls arching over the top produce a lens-shaped orebody; the fingers pitch toward the south. One of these large fingers on the 500-ft. level, called "No. 5 stope," extends about 400 ft. further south than the corresponding finger on the 400-ft. level; this is about 10 ft. high at the extreme south end, but gradually increases in hight until, near the north end, the ore is continuous to the level above.

THE MILL AND SOME OF THE MINES, BELONGING TO HOMESTAKE MINING COMPANY, AT LEAD, SOUTH DAKOTA

This stope was first worked during the years 1896 and 1897. At that time the entire sill-floor of all stopes was cut out and timbered with square sets. When the stope was too large to be worked as one above the "sill," small stopes were carried up with pillars of solid ore between them. These pillars were supported, where they had been undercut, by timber crib-work or bulkheads from 10 to 18 ft. high. The sill-floor of this stope contains 1260 sets covering an area of 45,360 sq. ft., for the sets are 6 ft. square. Before much of the ore was mined, the stope caved, crushing the bulkheads until they were not over 6 ft. high and in some places had the appearance of a solid piece of timber.

The levels above the 500-ft. were also worked in this manner. Some of the stopes were filled with waste, but many caved. In all cases the timber was left in; therefore the entire stope area is a mass of loose rock and timber, while scattered through this are numerous bulkheads built years ago to support pillars

*Assistant chief engineer of the Homestake Mining Company, Lead, South Dakota.

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of ore while the adjacent stopes were being worked. By referring to the map, reproduced in Fig. 1, and from what has been said, some idea may be obtained of the amount of timber within reach of the fire. It should be mentioned here that this method of mining has been discontinued and another method substituted whereby very little timber is used.

During the years 1900 and 1902 two small stopes were worked in one of the pillars of No. 5 stope, but both caved before they could be filled with waste. A drift, an extension of No. 4 crosscut (see map), was being opened through these caved stopes in order to reach a certain point, over No. 4 stope on the 600-ft. level, which was ready to be filled; it was in this drift that this fire started.

The deepest working of the mine is the Ellison shaft, which has reached the 1700-ft. level. More or less stoping and development work have been done on all the levels above that. There are approximately 50 miles of underground tracks, and the space, from which ore has been removed, is only a little less than 200,000,000 cu. ft. There are six regular working shafts reaching the 800-ft. level, four of these extend to the 900-ft. level, three to the 1100-ft level and two to the 1250-ft. level, while the Ellison has reached a depth of 1700 ft. All of these shafts are connected by drifts; there are numerous air shafts and waste and ore raises connecting the different levels. From every stope from one to four raises have been driven to the level above for ventilation and also in order that waste can be dumped down them to fill the stope when the ore has been removed.

Ventilation is good in all parts of the mine, some of the shafts being "downcast" and some "up-cast." In fact, there are so many openings from level to level that it was not considered practicable to seal up the part of the mine where the fire was burning; indeed the air courses are so intricate that the gases of combustion were rapidly carried to all parts of the mine. The workings above the 500-ft. sill floor are connected, by old raises and caved ground, with the large open cut which covers the entire length of the underground workings.

Origin and Discovery of the Fire

The fire started some time between 4 and 5 p.m. on March 25, 1907. Two miners were driving the drift described above and it is presumed that the timbers of the bulkhead, some of which were very dry, were set on fire by the flame from the blast or by a piece of burning fuse. It is not definitely known when the blast was fired. The miners reported that they blasted at three minutes after 4 o'clock and, in accordance with the rules of the company, went into the drift after the smoke had cleared away to make the usual examination for any incipient fire or "missed hole."

The fire was discovered by a watchman shortly after 5 o'clock. On leaving the 500-ft. station of the Golden Prospect shaft, he discovered smoke coming along the foot-wall drift. By reference to the map it will be seen that the natural air currents are toward the Golden Prospect shaft from the region of the fire. The watchman at once turned in an alarm, and

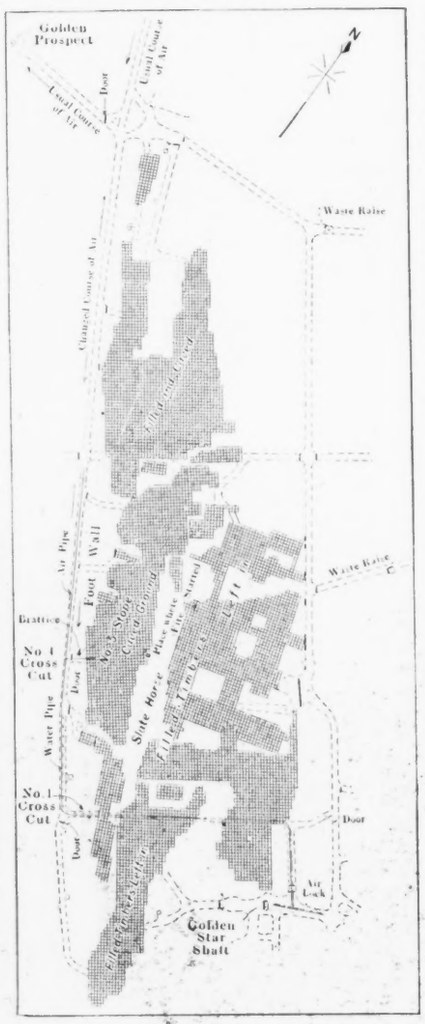


FIG. 1. MAP OF 500-FOOT LEVEL, HOMESTAKE MINE, SHOWING WHERE THE FIRE STARTED

in a short time men from all parts of the mine were summoned to help fight the fire.

Early Efforts to Reach the Fire With Water

The air pipes in nearly all parts of the mine are so connected with a series of water tanks located at the Ellison shaft, that water may be turned into them by shutting off the air from a certain line and opening a valve in the pipe connected to a tank. In this way water may be conducted to the most distant parts of the mine in a very short time. These tanks are located on every fourth level, and are supplied with water through a 6-in. pipe from the main reservoir. The air pipe, however, had been removed from the foot-wall drift on the 500-ft. level; for the crosscuts through the stopes were constantly settling, so that the pipe pulled apart and leaked. For this reason it was necessary to lay hose from the 500-ft. station of the Golden Star shaft, which was the nearest point to which water could be brought in pipes.

Two lines of hose were laid to the scene of the fire; one to the west side along the foot-wall drift into No. 4 crosscut, which was the only direct entrance to the fire; the other to the east side, by way of the main hanging-wall drift and a crosscut through Nos. 3 and 4 stopes.

It was hoped that the east line might be carried down through a winze to the top of No. 4 stope on the 600-ft. level, and thence up through a raise to the fire. This was never accomplished, for the smoke which filled the crosscut could not be driven back to the winze, although the men sprayed the crosscut with water from the hose, under a pressure of more than 200 lbs. per sq. in. The men who were fighting the fire in No. 4 crosscut were greatly hindered by the bursting of the hose, and were compelled to retreat several times to replace the broken hose.

As nearly all the smoke and gas came out through this crosscut, it was necessary to build a brattice so that the gas and smoke could be forced out on one side while the men worked on the other. Sixty feet of this brattice was built with considerable difficulty; it was necessary to spray the workmen constantly with water as they worked. The brattice enabled the men to check the progress of the fire until a water pipe was laid to replace the hose, which could not be trusted.

An air pipe was laid along with the water pipe. Valves and hose connections were placed in the air pipe about every third length. Each pipe line was approximately 1000 ft. long. The laying of the air pipe was made necessary owing to the formation of carbonic acid gas, which found its way through the old stopes into the No. 1 crosscut and the foot-wall drift, and later to all parts of the mine. The gas spread so rapidly that the men were greatly hindered in the work of laying the pipe lines, and it became necessary for them to work in relays of 15 minutes, each relay being in charge of a foreman. When relieved, each relay proceeded at once to the shaft and was hoisted to the surface, where the men could breathe pure air until their turn came to go below.

An attempt was made to close all openings into the crosscut and the foot-wall drift. The roof and sides of the crosscut were boarded up tight with 1-in. boards and battens. In closing a drift,

the usual method was to stand 3x4-in. uprights, with 1-in. boards nailed on both sides, the space between being filled with wet clay. A cheaper and quicker method used in some places was to nail the boards on one side only, in the manner of lap siding, but upside down, the ledge formed by the lap being daubed with clay to make the joint air-tight.

As the air in the Golden Star shaft (which is "up-cast," and through which the men were lowered) was charged with a considerable percentage of gas, an air lock was built near the 500-ft. station in which the men could stop for a few minutes on the way to and from the fire. This lock was made by closing a part of the drift with doors, the air inside being kept pure by the admission of compressed air. A man was stationed in this lock whose duty it was to issue a check to each man as he passed through the lock on the way to the fire, and to see that all checks were handed back when the relay returned. In this way it was almost impossible for a man overcome by gas to be left behind without being missed in time to be safely rescued.

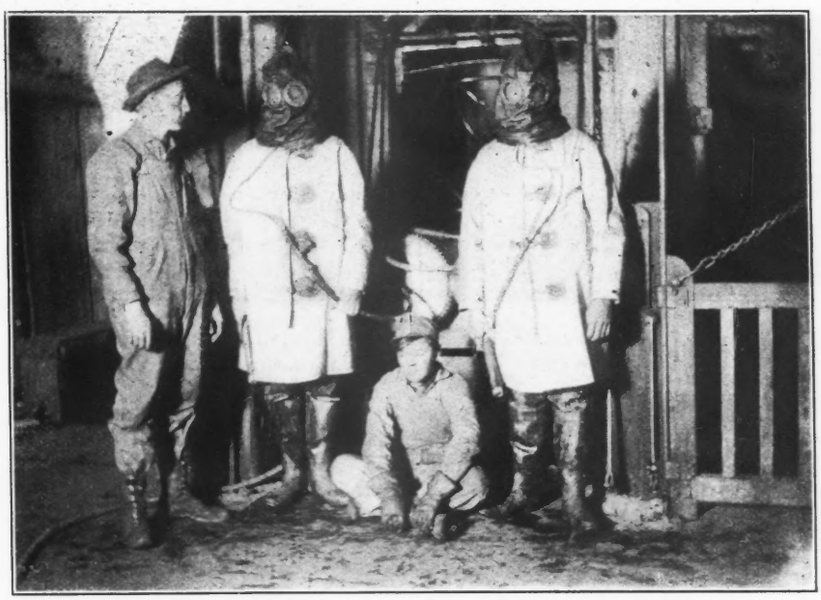
TEMPORARY PIPE FROM CITY MAINS TO THE OPEN CUT OF THE HOMESTAKE MINE

After the pipe lines were finished an attempt was made to get at close quarters with the fire. The two men at the nozzle were provided with leather helmets, which were fed with compressed air from the air main through a small hose. These helmets were made by the company's harnessmaker, and fitted up at the machine shop. With these the men succeeded in getting close to the fire, and were doing effective work when the crosscut began to cave behind them and they were forced to retreat. Soon after this the crosscut became completely filled, so that a part of the fire was entirely shut off from further access. The caving of this crosscut was no doubt caused by the fire burning out some of the timbers of the stope below, so that the water caused the fill to settle.

The Attempt to Smother the Fire With Steam

When it was found that the fire could not be reached with water, it was decided to close up all openings into the fire area on this level and endeavor to smother the fire by introducing steam. It was thought that the vapor might find its way through the caved rift and thus reach all parts of the fire. The openings most difficult to close were Nos. 4 and 5 crosscuts; the opening along the north side of the brattice in No. 4 crosscut was a veritable smoke flue. The greater part of one night was taken to close this opening. That part of the crosscut on the south side of the brattice was first sealed up with boards and clay, a small trap door on hinges being provided so that observation might later be made as to the effect of the steam. A narrow slot about 6 in. wide was then sawed through the brattice boards just in front of the part already closed, and 3x4-in. pieces were shoved through this slot until they were tight against the further wall and one on top of another until the back of the crosscut was reached. The openings left at the top and bottom, owing to the unevenness of the rock, were then closed with bags of clay and cotton blankets. In order to accomplish this last task, a hole large enough to admit a man was cut through the brattice and covered with a trap door. A man carrying a bag of clay would pass through this door and push the clay into the opening, while a comrade would play a stream of air around his head to keep away the smoke and gas. When the No. 4 crosscut was closed, the air pipe was extended along the foot-wall drift until the next crosscut was reached; this was closed in a similar manner, as was each in turn until all were closed.

As soon as these openings were closed, a door was placed in the drift leading to the Golden Prospect shaft which turned the strong air current, coming from the north, down the footwall drift. This effectually cleared the gas from the drift so that, during the remainder of the fire fighting, men could work here for the full 8-hr. shift. But closing these openings on the 500-ft. level did not confine the gas, for it found its way upward through the caved ground to the upper levels and thence downward through No. 4 stope to the 600-ft. level and to the other parts of the mine.



MEN WITH AIR HELMETS, READY TO GO DOWN AT THE ELLISON SHAFT

The steam was furnished by the regular battery of boilers at the Golden Prospect shaft. The steam pipe was connected to the air pipe at the surface, and the steam conducted down the shaft to the 500-ft. level and thence to the No. 4 crosscut through the regular air pipe. A considerable length of this pipe had to be re-laid because, as has been said before, the air pipe had been removed from the footwall drift. No unusual difficulties were encountered in this part of the work, except that several joints of the air pipe in the shaft leaked badly when the steam was turned on and had to have new gaskets. The Golden Prospect shaft, being upcast, carried considerable gas; this added to the difficulty of repairing the leaky joints.

Steam was turned into No. 4 crosscut for 7½ days. It is presumed that some of the steam condensed in the pipe before it reached the end, but the pipe kept going until the morning of April 2. During the previous night the engineer and his assistant attended to their duties protected by helmets. They worked in 4-hr. shifts, and reported by telephone every 20 minutes so that it would be known that they were all right. About 10 a.m. on April 2, those on the surface failing to get a report at the regular time, a rescue party was sent down, who found both men nearly exhausted. They were brought to the surface and the pumps were abandoned. From this time until it was decided to flood the mine, the water was kept down by 500-gal. skips installed at the B. & M. shaft.

Work of the Hospital Corps

Before passing on to the further description of the fire fighting, it may be of interest to say something about the work of the hospital corps in taking care of the men overcome by gas. A temporary hospital was opened in the "change house," where one doctor was always in attendance and sometimes two were kept busy. Restoratives and emetics, and such instruments as might be needed in an emergency, were kept handy. A mess was also established in a part of the same building, where substantial food was served at all hours, night and day.

In considering the effects of gas it is important to remember that the collars of the principal shafts of the Homestake mine are at an average hight of about a mile above sea level, so that the workings above that point at which the fire broke out are at an average elevation of 5000 ft., corresponding to a barometric pressure of about 25 in. of mercury. This means that the atmosphere has only five-sixths of its normal density, or, in other words, under ordinary conditions there, a man takes in at a breath fully 16 per cent. less oxygen than at sea level. Any diminution of the supply of oxygen is therefore more serious than at lower altitudes.

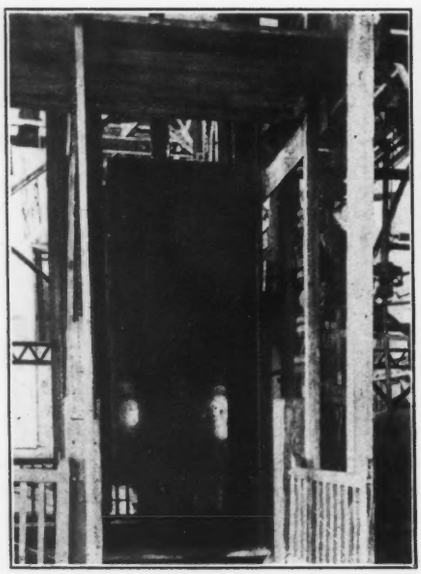
We found that there were no serious conditions following the effect of the gas. There were a few cases of bronchitis for a few days, but we attributed this more to the smoke than the gas. One case coughed blood for 24 hours. Some were unconscious for two hours, but came out all right without any serious results. There were no fatal cases during the fire, nor any since attributed to it.

The emergency hospital was established on March 26, and was kept open night and day until April 2.

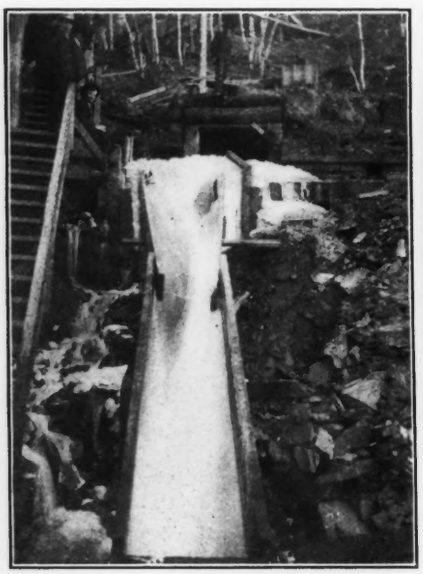
Advancing Drifts Through Red-hot Rock

An exploring party made an investigation at No. 4 crosscut soon after the steam was turned off. No fire could be seen, and the temperature inside of the door was found to be 94 deg. Fahrenheit. In order to determine what the fire was doing or had done, the door and brattice in the crosscut were taken down and men were put to work to re-open the crosscut through the cave.

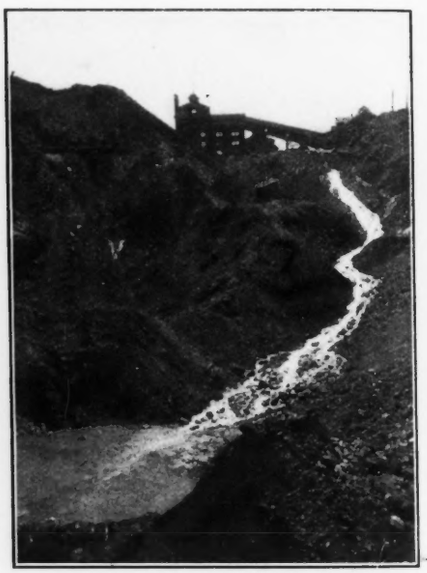
Before this work had progressed very far a piece of burning timber was discovered in a small drift leading north about 20 ft. Another gang of men was set to work to open this drift with the hope of finding some part of the stope timbers still standing which would give a chance to get at the fire and discover its extent. When these drifts had been advanced about 20 ft., the temperature began to rise, and in a short time red-hot rock was encountered in the faces of



2000-GAL. SKIP USED AT ELLISON SHAFT FOR HOISTING WATER



WATER COMING OUT OF NORTH END TUNNEL SHOWING FOAM CAUSED BY GAS



OPEN CUT, HOMESTAKE MINE, SHOWING WATER FROM TEMPORARY PIPE LINES

where it entered the door at the crosscut was hot enough to bake the clay in the joints, so that it required constant wetting to keep the joints from leaking gas.

During the 14½ days from the breaking out of the fire until the steam was turned off, the mine foreman and his assistants were making heroic efforts to keep up mining operations on the lower levels, but the gas finally drove them out of every part of the mine except the extreme north end, where a very strong current of air from the surface held the gas back. One mule on the 100-ft. level, one on the 1000-ft. level, and two horses on the 1250-ft. level were lost on account of the gas spreading so rapidly that they could have been rescued only at great risk to the lives of the men.

The main pump located on the 1100-ft. level near the Golden Star shaft, was

both drifts. The timber had been practically all consumed, and only occasionally would a shovelful of charcoal be found.

One large quartz boulder weighing perhaps 300 lbs., which rolled down into the drift, was so hot that after a stream of water had been playing directly on it for five minutes, it still appeared red in the center, and when broken open was almost at a white heat in the center. The work of mining red-hot rock was kept up for 13 days, during which time 1782 carloads of rock was taken out of the two drifts, nearly all of which had to be cooled with water before it could be handled. No determinations of the rock temperatures were made, but it is safe to say that temperatures of 1500 deg. Fahrenheit existed. The men loading the cars and timbering the drifts worked in short relays, two men loading a car and pushing it out to the main track while two fresh men would take the empty car in and load it.

Some water was constantly dripping from the backs of the drifts. This probably came from the surface, as two pipe lines and several lines of hose had previously been laid to the open cut just above the location of the fire, with the idea that some of the water might find its way down to the fire. Some of this did reach the fire, and, on its way down through the warm rock, was heated until it was quite uncomfortable to the bare hand.

At times when the rock "hung up" ahead of the drift, masses of red-hot rock could be seen 12 or 15 ft. above the back of the drift. In order to cool these places a hose was fastened to the timbers, pointing toward the center of the masses; then, when all were safely away, the water was turned on. The water striking the red-hot rock would cause a great rush of steam into the drift, which would sometimes force the workmen to retreat 100 ft. or more. The cold water would break the rock and cause it to "run."

As the work of drifting seemed too slow to accomplish any good, an attempt was made to start a raise in the footwall in order to get above the fire. But this had to be abandoned, as the concussion from the blast knocked down all the doors and brattices and allowed the gas to escape into the footwall drift.

Flooding the Mine

After these various attempts to reach and subdue the fire had failed, it was decided to flood the mine. Various predictions were made by both experienced and inexperienced mining men as to the disastrous results of this course. One man of considerable prominence in Western mining predicted the destruction of the mine by explosions when the water should reach the fire. However, those in authority, after due consideration, decided this was the only course remaining. Therefore, on April 18, the skips, which had been used to clear the mine of water, were stopped and the water, which had previously been turned into the open-cut, and the underground water, was allowed to fill the lower workings.

On the morning of April 22, the men were ordered out of the mine, and all mining operations were stopped. By this time the water had risen to the 1250-ft. level. The machine-shop force immediately started to make skips for all the hoists, and to get the hoisting engines in shape for the unwatering. Work was undertaken to secure all the available water for filling the mine, and was carried on with all possible speed. Pipes were laid from the regular mill and city mains to the open cut, and water pipes leading into the mines were opened. The quantity of water available from the regular supply when all the mills were stopped, which was April 23, was 1280 cu.ft. per minute.

One of the temporary pipe lines is shown in an accompanying illustration. The first part of the line is made up of short lengths of 12-in. cast-iron pipe, while, farther along, curved pieces 4 ft. long are laid with sleeve joints calked with oakum and lead. When all the 12-in. pipe on hand was used, a reducer was put on and the line was finished with 8-in. pipe.

The season had been very dry up to this time, which is very unusual for the Black Hills. Whitewood creek was flowing only about 100 cu.ft. per min. However, snows or rains might be expected at any time, and it was decided to build a flume to carry the water of the creek into the mine through the Savage tunnel. The mouth of this tunnel is about 30 ft. lower than the 300-ft. level, and is connected with a drift on the 300-ft. level by a raise 15 ft. high, about 2,000 ft. from the mouth. This necessitated carrying the water in a flume, around the side hill over the tunnel and dropping the water through a raise, the mouth of the tunnel being closed with a timber bulkhead made of 12x12-in. timbers laid horizontally. It may be of interest to note that the Savage tunnel with the two raises constituted an inverted siphon. The flume was 3200 ft. long, 36 in. wide, and 18½ in. deep, with a grade of 0.2 per cent. It was built of 1½-in. native pine lumber, surfaced on one side and edged, sawed at the company's mill. The box was laid on 3x4-in. sills spaced 3-ft. centers with 3x4-in. uprights nailed to the sills and braced with 1x3-in. diagonals, nailed to the side of sill and post. The posts were tied together at the top with 1x3-in. strips. End joints had a string of marlin, inserted before the boards were butted up; later these joints were pitched. Horizontal joints were battened with strips of building paper and a ½x2-in. strip.

Snow fell before the flume was finished; when the water was first turned in on April 30, 220 cu.ft. per min. were available. This increased until as much as 916 cu.ft. per min. were flowing. Altogether 15,912,000 cu.ft. of water were carried into the mine through this flume in 22½ days.

At the north end of the mine the 300-ft. level opens to the surface through what is known as the North End tunnel, the mouth of which is about 15 ft. above Deadwood creek. At this point a sinking pump was installed in a bed-rock shaft, to pump from the creek into the mine. This pump was in continuous operation from May 5 until May 30, pumping through three 4-in. pipes and furnishing altogether 3,000,000 cu.ft. of water.

Preparing the Mine for Flooding

After it was decided to flood the mine, all of the shafts were boarded up at the stations, to keep out floating timber, which would later interfere with the skips when the work of bailing should begin. On account of the gas, the men were compelled to use helmets. The tanks sent with these helmets were not large enough to furnish a sufficient quantity of air for any length of time.

In order to provide sufficient air storage, two ordinary hot-water tanks, one of 66-gal. and one of 52-gal. capacity, were used, and provided with connections for the small hose attached to the helmets, and for a pressure gage. These tanks were charged from the main air pipe to about 70 lb. per sq.in. pressure and placed on the cage. When the two men were ready to go below, they would put on the helmets and turn on what air they considered necessary and they were then lowered to their work, remaining below for short periods only. On coming to the surface they would re-charge the tanks.

The mouth of the shafts and all other openings, through which air could reach the fire, were closed in order to keep the fire from spreading to the upper levels before the water could reach it.

When the water reached the 300-ft. level, the Golden Prospect shaft was uncovered and an exploring party went in on the 300-ft. level as close to the fire as the gas conditions would permit. By testing the air currents coming from the fire area it was found that gas was still forming; and considerable heat was manifest, although no fire could be seen. After this examination it was thought best to bulkhead the Savage and North End tunnels and flood the 300-ft. level.

The bulkheads were built similarly to the one already mentioned, except that more care was exercised to make the ends of the timbers fit the sides of the tunnel. A rough hitch was first cut in the sides, and then dressed to fairly good

surface with moils and stone hammers. The timbers were cut to a neat fit, and the ends as well as the longitudinal joints were calked with oakum; short pieces of pipe provided with valves were put through the bulkheads to let the water out. The valves in the Savage tunnel bulkhead were never opened, however, as gas leaked through and fouled the tunnel so that they could not be reached. Those in the North End tunnel, being nearer the mouth, were opened, although the gas made the task difficult. Later a hole was cut through which allowed the water to flow out freely.

TABLE I.—ANALYSES OF AIR IN HOMESTAKE MINE DURING THE FIRE.

Time and Place.	Carbon Dioxide. Per Cent.	Carbon Monoxide. Per Cent.	Oxygen. Per Cent.	Nitrogen by Difference. Per Cent.
April 2, 500-ft. level, behind door, in vicinity of fire after being sealed four days............	15.7	present	4.25	
April 11, Golden Star shaft (up-cast) at 300-ft. level....................................	3.7	trace	17.3	
May 2, Golden Prospect shaft (up-cast); tramway level....................................	13.4	0.1	6.4	80.1
June 3, 300-ft. level, south end, after flooding....	1.95	0	18.2	79.85
June 24, 300-ft. level, south end, after flooding...	1.9	0	18.3	79.8

During the time that the water was rising on the 300-ft. level, the 200-ft. was closely watched to see whether the gas would disappear. It gradually diminished until, on May 29, less than 1 per cent. was found where 4 per cent. was present but a few days before. As the immediate vicinity of the fire was inaccessible, the status of the fire had to be determined by the presence or absence of gas. Tests were made by the chemist several times each day, and when these showed a constantly diminishing amount the conclusion was reached that the water had overtaken the fire.

Analyses of the Air

During the progress of the fire and the flooding of the mine, some hundred of samples were taken of the air at various points, and quantitative analyses of these were made—some to ascertain whether it was dangerous to breathe, but the majority to give indications as to the probability of the continuance of combustion. In most instances it was necessary simply to estimate the percentage of carbonic acid; in others, oxygen, carbonic acid and carbon monoxide were estimated by Orsat's apparatus, or the presence of carbon monoxide was tested qualitatively by means of palladium chloride.

The samples were usually taken in duplicate in dry bottles by means of a hand pump, a bicycle pump being remodeled for the purpose and fitted with a suction hose by which samples could be drawn from otherwise inaccessible places. When samples were necessarily taken hurriedly, bottles of distilled water were emptied at the desired spot; but in such cases the percentage of carbon dioxide found was always slightly too low, owing to a little being dissolved by the water.

A half-inch armored hose, such as is used to supply air drills, was lowered from the collar of the Golden Star shaft to a point somewhat below the 300-ft. level, and samples were taken through this several times daily, after a sufficient volume had been pumped out to insure the entire displacement of all air contained in the hose. Other exits of the products of combustion being almost entirely shut off, a fair idea of the energy of combustion could be obtained from the samples coming from a fixed point. The variations thus observed for some weeks are shown by the curves in Fig. 2. Some of the fluctuations are due to minor causes, but in the main they correspond to conditions in the fire area.

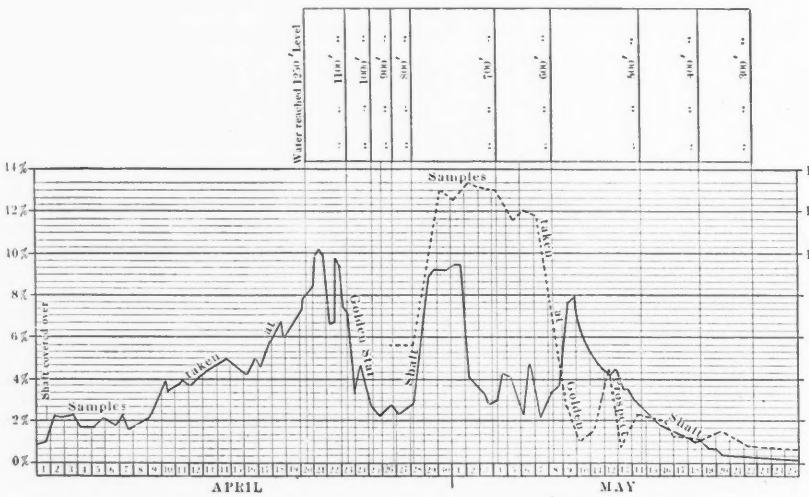


FIG. 2. CURVES, SHOWING PERCENTAGES OF CARBON DIOXIDE IN THE AIR AT THE GOLDEN STAR AND GOLDEN PROSPECT SHAFTS DURING THE FIRE

Table I shows typical analyses of the air.

Other samples from behind doors in the fire area yielded from 4 per cent. to 14 per cent. carbon dioxide, and showed the presence of small amounts of carbon monoxide. Water bailed during the first week of the fire was found to contain from 2.2 per cent. to 3.5 per cent. by volume, of carbon dioxide. A number of samples of air taken from May 21 to May 23, near the Golden Prospect shaft on the 300-ft. level after the water had nearly reached that level, yielded from 6.4 per cent. to 9 per cent. carbon dioxide and less than 0.1 per cent. carbon monoxide. It was impossible to breathe this air more than a few minutes without distress, and continued exposure produced headache and weakness of the knees.

There is a decided excess of nitrogen in some of the analyses quoted, over the 79.2 per cent. found in normal air, which is not affected by the burning of carbon or of wood fiber to carbon dioxide, for the carbon dioxide occupies the same volume as the oxygen consumed. This is due either to (1) absorption of part of the carbon dioxide by water; (2) combustion of "pitchy" wood, the excess hydrogen of which converts part of the oxygen into water; or (3) absorption of oxygen by sulphides in the rock. At times sulphur dioxide and hydrogen sulphide could be detected when moist, heated rocks were being removed from drifts in the fire area, but only traces of these were present.

The water reached an elevation of 78 ft. 8 in. above the 300-ft. level at midnight of May 29, and was then shut off. The time required to fill the mine from the 1550-ft. level to the point named was 39 days 17½ hours. The space to be filled was estimated at 80,000,000 cu.ft. The progress of the filling is shown by the curve in Fig. 3, which curve is carried out to show the relative time occupied in unwatering. The ordinates of the curve are the estimated cu.ft. of space to be filled.

Unwatering the Mine

Bailing with skips began at the B. & M. and the Golden Prospect shafts on May 30. These skips have a capacity of 1000 gal. each, and at these two shafts the water was hoisted to the surface. At the Ellison shaft, 1000-gal. skips, which had been built several years before, were used until the water was lowered to the 300-ft. level, when 2000-gal. skips were installed which were dumped on the 300-ft. level.

The water found its way to Whitewood creek through the Savage tunnel, which tunnel was thus used both in filling and unwatering; 500-gal. skips were also installed at the Golden Gate shaft, and they were also dumped on the 300-ft. level, the water being carried to Deadwood creek through the North End tunnel The bulkheads in this and the Savage tunnels had been taken out as soon as the water was lowered sufficiently to permit its being done with safety.

All of the skips are of rectangular section with flat bottoms, and are provided with one door in the bottom, which is both a discharge and an inlet, and a second door, also in the bottom, which acts as an inlet only. The discharge door has a sloping lip underneath to deflect the water from the shaft. The door is opened automatically by a trip which strikes a wooden runner fastened to the guides. These skips were all built at the company's machine shop, and were made after the decision to flood the mine was reached The material for the large Ellison skips had to be obtained from Chicago.

A system of air lifts was installed at the Ellison shaft, which proved to be of great assistance. Two 8-in. pipes were lowered from the 300-ft. level to the 800-ft. level in the pipe compartment, and a 2-in. pipe was put inside of each 8-in. pipe extending down about 240 ft. below the discharge. The 8-in. pipes had a conical end at the bottom, provided with 2-in. holes in the surface of the cone. The area of these holes is about 2½ times the area of the pipe cross sections. On the lower end of the 2-in. pipe were pieces of pipe about eight inches long with numerous small holes in the circumference, pointing upward at an angle of 45 deg., the ends of the pipe being closed with a cap. The discharge ends of the water columns were provided with special curved elbows, having flanged openings through which the air pipes entered. Fig. 4 shows the arrangement of piping for these air lifts.

A 6-in. pipe, which is a part of the mine-fire service and which connects a tank on the 200-ft. level with one on the 600-ft., was taken apart at the 300-ft. level and a 1-in. air pipe lowered inside. This pipe threw considerable water until the water was lowered 200 ft., although there was one tee and one elbow at the lower end. Both 8-in. water columns were made of screw-connected pipe, put together a length at a time, and lowered by block and winch. Air at 80-lb. pressure was first used, but when the air pipes were lowered, air at a pressure of 85 lb. was turned into one of the columns.

When the air-lifts were discontinued the high-pressure line was lifting water 336 ft. with a submergence of 171 ft., and the low-pressure line was working against the same head with a submergence of 135 ft.; the two together were raising about 600 gal. per min. When the three pipes were at their best efficiency they raised 4,397,000 gal. in 24 hours, with the water level standing 87 ft. below the discharge and a submergence of the air lines of 157 ft.

Quantity of Water Handled

The total amount of water pumped from the mine by the air-lifts was 83,469,000 gal. The average per day, during 31 days, was 2,692,550 gal. The total amount hoisted and pumped from the mine during this time was 309,891,500 gal., of which the air-lifts raised 26.9 per cent. The best record for 24 hours made by all of the skips was 8,724,000 gal., and the Ellison alone hoisted 4,500,000 gal. in 24 hours from about 185 ft. below the 300-ft. level. The total amount hoisted by the skips was 540,999,000 gal., and 18,984,000 gal. was pumped by a Cornish pump at the B. & M. shaft, making a grand total of 643,452,000 gal. of water taken from the mine from May 30 to Sept. 6.

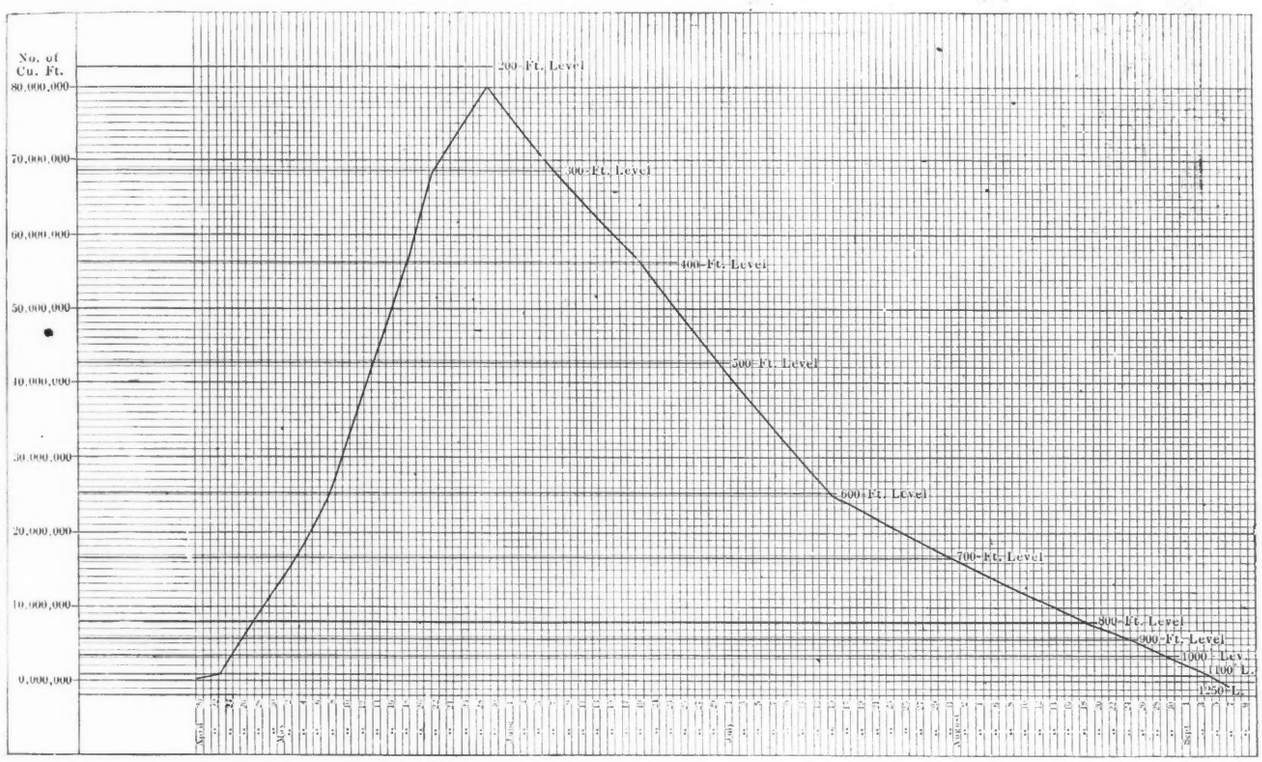


FIG. 3. CURVE, SHOWING PROGRESS IN FILLING AND UNWATERING HOMESTAKE MINE

As shown in the accompanying illustration, the water foamed very freely whenever agitated. Analysis of this water showed a marked increase in sulphates of lime and magnesia, and the presence of some iron as ferrous sulphate and carbonate. On exposure to air the iron was immediately and completely deposited as ferric hydroxide, coloring the rocks of the creeks for a long distance below the mine outlets. Much organic matter was also present.

Old iron pipes and steel cars, already coated with rust, were but little affected by the submergence. Greasy metal was practically unaffected. Some new iron

pipe, however, acquired a rather thick, black and slimy coating. Analysis of the entire coating scraped from a measured area of pipe showed that the iron contents corresponded to the corrosion of an average thickness of much less than 0.001 in. of metal. The deposit consisted of ferrous and ferric hydroxide, and a considerable amount of carbonaceous material, the latter apparently due to the original coating of the pipe.

Nearly all drilling machines and five compressed-air motors were left in the mine; none of these seem to be injured to any great extent, for all were put into service again as soon as the dirt was cleaned off. Some of the small drills for block-holing were not even cleaned, but were given a thorough oiling and put to work. The large steam pump located on the 1100-ft. level was given a complete overhauling and was started up Oct. 7. All hollow parts of this pump were found to be filled with water and air considerably compressed.

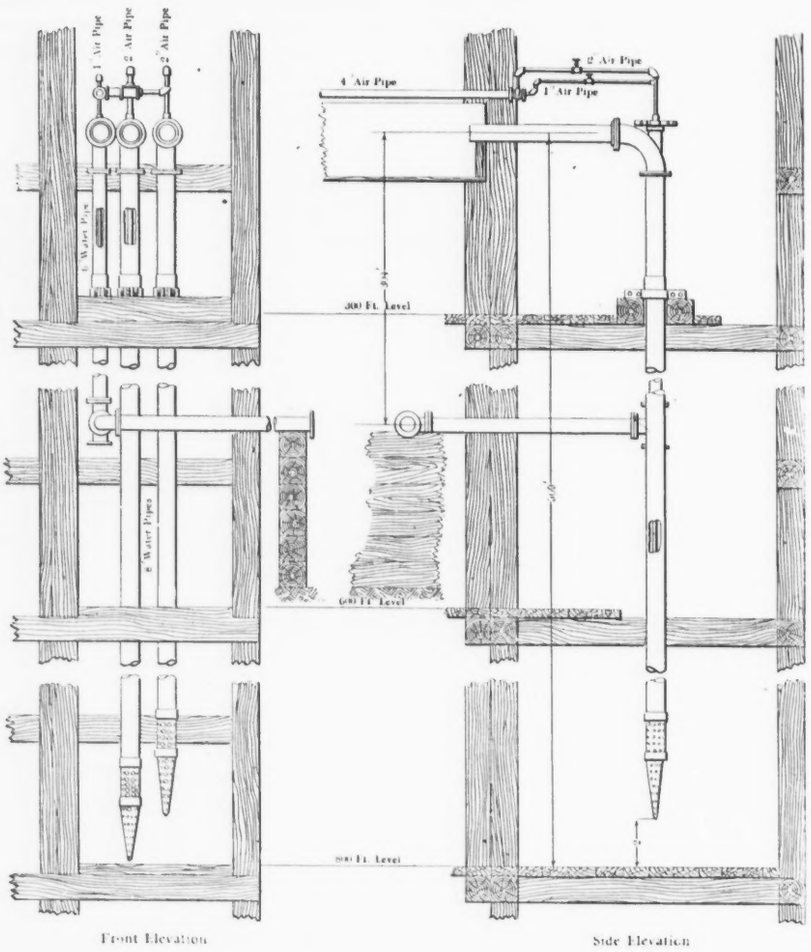


FIG. 4. AIR-LIFT PUMPS USED IN UNWATERING THE HOMESTAKE MINE

Condition of the Mine

The physical condition of the mine is excellent, considering its prolonged bath. Some of the older timbered stopes and drifts caved, but on the whole very little work was required to put the mine in good working condition. Some mud was deposited in the low parts of the levels as far down as the 500-ft., but the lower levels have the appearance of having been washed. This mud deposit was brought down by the water from the surface, through the open cut. Considerable loose timber had floated into the drifts; three or four days, however, would suffice to put a level in shape to produce ore.

The unwatering was completed to the 1550-ft. level on Oct. 7, without mishap of any kind. Some of the mills were started on surface ore, as soon as the water was turned out of the mine and became available for the mills. As the different levels were cleared, more stamps were put in operation, until on July 12 all of the 1000 stamps were again crushing ore after a complete shut-down of 37 days.

Some Observations and Lessons

It was found necessary to use electric current to furnish light where carbon dioxide was present in the proportion of 2 per cent. or more.

It was found that a man could walk at least 500 ft. in air containing 8 per cent. carbon dioxide, and remain in such an atmosphere from five to ten minutes.

By experiment it was found that charcoal fires, even when a considerable mass was strongly glowing, ceased to glow when the carbon dioxide rose to about 7 per cent. The fact that over 15 per cent. was found behind some of the doors in the fire area is probably due to the effect of the rocks, already strongly heated and thus favoring the combustion of charred timbers in contact with them.

Too much care cannot be exercised to prevent fires in a mine when timber is used, and all rules for prevention should be very strictly enforced.

A good system of water pipes, maintained even in the old, worked-out parts of a mine, is essential. A small squad of men, who are familiar with all parts of the mine and with all water pipes and hydrants, and who could be drilled once a month, might do good service at the beginning of a fire. There should be one such squad for each shift, and the regular drill should never be omitted. Upon these men should fall the duty of seeing that all fire-fighting apparatus is in good working order.

Helmets such as are made for rescue service are not trustworthy, and are good only for short periods of time. As built, they are too cumbersome and hinder the vision of the wearer.

Tamping Dynamite Charges

Tamping in holes loaded with dynamite is a source of danger if the hole is completely or nearly completely filled with tamping from the vein. Careful search will often fail to locate such a hole that has missed. Any good effect from tamping, other than to keep sparks from igniting the dynamite or to keep the fuse in the hole when hit by flying rock, is questionable. A few inches of tamping is as good as a foot for protecting the dynamite and retaining the fuse. The use of more tamping consumes more time, and increases the danger arising from missed holes by tending to conceal them in case they are tamped full to the collar. The use of a foot or 16 in. of tamping is almost as bad; for, if the hole is cut off by another blast, it is possible that the stump of the hole left will be completely filled with tamping and therefore hard to locate. Besides, if only a few inches of tamping is used and the hole misses, the primer can be inserted on top of the tamping and the hole blasted without any picking out of tamping. When one considers that often holes are cut off and the charge of dynamite cut in two without its being detonated or ignited, it becomes questionable whether the hole will detonate properly if many inches of rock tamping intervenes between the charges.

Experimental Studies on the Work of Water Jigs*

By N. V. Hansell†

For the last 50 or 60 years the laws that govern the work of the ordinary water jig have been the subject of investigation and speculation, but they have only recently been thoroughly worked out and understood. The reason for this is that the conditions by which the results of the jigging process are determined are so complicated that it is difficult to ascertain which factors are more important, or how the forces acting on the material assist or retard one another. Von Rittinger and von Sparre tried to find a solution by speculation, assuming that the material falls in water at rest. It was soon demonstrated, however, that the influence of the up-going and down-going currents had to be taken into consideration. Professor Munroe added the idea of the ore grains traveling in "narrow channels" (interstitial currents) and Professor Richards introduced the theory of suction.

G. G. Bring calls attention to the experiments of Professor Hoppe, of Clausthal, and Professor Richards, of Boston. When the free fall of grains in quiet water is considered, it is found that the grains travel with increasing velocity until the resistance of the water equals the accelerating force. From this instant they continue with a constant speed called the maximum velocity. If they fall long enough, small grains of high specific gravity reach the bottom simultaneously with larger ones of less. Hoppe and Richards, basing their recommendations for practical work on this conclusion, advised a close screening, because the use of consecutive screens with apertures greatly differing in size would result in concentrates made impure by coarser rock grains. This belief has been general up to the present, but it has recently been shown that it is correct only to a certain degree, as the working conditions of the jig are very different from those anticipated.

Rittinger gave the formulas for the travel of a grain in the ascending and descending currents, and showed that in the latter case small ore grains can easily be separated from large rock grains with less specific gravity.

Fall in Narrow Channels

In 1889 Professor Munroe published his opinion that there is no free fall of grains in the jigging process, but a fall in narrow channels. He came to this conclusion after a close study of the American methods of jigging, which were developed from the English practice. American methods treat material very much less classified than is allowed by practice on the Continent. He made about 600 trials (*Trans.*, A. I. M. E., 1889), and among his conclusions was also that grains *en masse* act as single grains, an opinion which has been criticized by Professor Köhler and others. Munroe gives the following formula for the maximum velocity v of grains falling *en masse* in narrow channels:

$$v = 0.833 \sqrt{d(\delta - 1)}.$$

In this equation, d signifies the diameter of the grain (sphere) and δ its specific gravity. To show which grains fall with equal velocity, the following example may serve:

Quartz with a specific gravity of 2.65 and a diameter of d and blende with a specific gravity of 4.10 and a diameter of d_1. Inserting these values in the formula, we get the equation

$$0.307 \sqrt{d(2.65 - 1)} = 0.833 \sqrt{d_1(4.10 - 1)},$$

$$\text{or, } d : d_1 = 14 : 1.$$

According to Munroe, this formula is in this instance correct, because the large quartz grains are surrounded by small ore grains, and the small ones by others of equal or greater diameter. Consequently, as the grains in a jig fall in water currents through narrow channels, it is feasible to separate quartz grains with a diameter of 14 mm. from blende grains with a diameter of 1 mm. It must, however, be remembered that the impurities of the concentrates, even in this case, consist of the largest rock grains if the formula is correct.

G. G. Bring having discussed the theories which have been advanced as to the conditions governing the work of the jig, endeavors to show how the grains really act in water at rest, in up- and down-going currents generally, and especially in currents through narrow channels, and he describes in this connection a number of trials made by himself and others.

Influence of Currents

Some tests made by Professor Richards show that grains with greater specific gravity and greater diameter, when falling in water at rest, have greater velocities. Consequently the fine ore grains are mixed with the coarser rock grains.

In regard to the behavior of the material in ascending currents, the tests made by Richards and described in the *Trans.*, A. I. M. E., 1899, and in his "Ore Dressing," have been repeated by Mr. Bring, who arrives at the same conclusions. The coarser rock grains become mixed with the finer ore grains both when the material is drawn upward by the water current and when it falls in water at rest.

When the influence of descending currents is tested, it is necessary to take into consideration that of the narrow channels. Bring refers to Hoppe's tests, the results of which were published in 1888. Hoppe found that the grain of less weight reaches the bottom sooner than the heavier one, which was contrary to the general belief. He did not try to explain this, but as we have seen that in still water and ascending currents the heavier grain moves more rapidly than the lighter one, we reach the conclusion that this phenomenon is caused by the descending current or by the narrow channels, or, most probably, by these two together.

Hoppe also states that 3-mm. and 5-mm. grains act differently when jigged with a bed of grains from 13 to 18 mm. This conclusion he reached after having worked with both sizes with screen apertures which let the 3-mm. grains go through but kept the 5-mm. grains mixed with the bed. If he had used a screen with holes of sufficiently larger size, the 5-mm. material would have gone through just as the 3-mm. did. Mr. Bring demonstrated this by several experiments, because Richards in "Ore Dressing" recites Hoppe's conclusion without mentioning that it is incorrect.

Richards has made a series of tests by which he has shown that for the jigging of classified material as little suction as possible is advantageous, while in the jigging of unclassified material, on the contrary, a strong suction ought to be used to accomplish quick separation.

Behavior Under Suction

To determine the influence of the down-going currents and of the narrow channels, G. G. Bring made a series of tests on an ordinary continuous jig. A sieve with 7-mm. holes was used with a bed of 8- to 10-mm. grains. The material to be jigged had passed through a 5-mm. screen, but was otherwise just as it came from the crusher. The tests were carried on with limestone of 2.72 specific gravity, granite of 2.60, and magnetite of 5 as testing material. In the paper the tests are described in detail, and are accompanied by numerous tables and illustrations. The conclusions reached are the following:

(1) *Increased thickness of the bed* causes decreased "hutch," with less diameters and smaller factor (the proportion of the diameters of the heavier and the lighter material).

(2) *Increased size of the bed grains* causes greater amount of hutch, lower percentage of metal in the hutch, greater dimensions, but smaller factor.

(3) *Decreased quantity of testing material* causes increased amount of hutch, greater diameters, and smaller factor.

(4) *With more limestone in the crude mixture* there are a lower percentage of concentrates in the hutch, larger diameters, and larger factor.

(5) *With more magnetite in the mixture;* greater percentage of metal, smaller factor.

*Abstract of a paper by Gust. G. Bring, *Jernkontorets Annaler*, 1906, p. 321.

†Mining engineer, 29 Broadway, New York City.

(6) *Smaller size of limestone;* more hutch, lower percentage of metal, less diameter of the magnetite grains but larger of the limestone grains, less factor.

(7) *Increased number of revolutions;* more hutch, higher percentage of metal, less diameters, and a considerably increased factor.

(8) *Increased length of stroke;* more hutch, higher percentage, larger diameters, and larger factor.

(9) *Increased specific gravity of the lighter material;* increased diameter, smaller factor.

(10) *Elimination of the fine limestone grains;* less hutch, but a greatly increased percentage of metal.

In a few words, it is thus shown that the grains of the lighter material which pass through the bed with those of the heavier are always finer in the average than the latter. Also the proportion of the diameters of the heavy and light grains which travel together is not constant but varies with varying conditions.

Special tests in order to distinguish the influence of down-going currents and that of the narrow channels demonstrated only that both these factors bring together large grains of a heavier material with small grains of a lighter one.

A number of tests were made by Mr. Bring on ordinary jigs in operation in order to find the relative efficiency of the different periods of their work, and he has arrived at the following conclusions: In a modern jig the up-going and down-going currents cause the separation. In the coarse jig, the former have the greater influence; in the fine jigs, the latter. The bed with the layer of ore on its top can be considered as a series of narrow channels in which the currents travel up and down. The separation in the jig is caused by a happy coöperation between these up-going and down-going currents.

Value of Classification

In Europe, it has always been the practice to classify the ore to a very high degree before jigging. This practice is now slowly changing, as it has been found that it only complicates the plant without being of any benefit, particularly if the difference in specific gravity between the minerals to be separated is great. Some classification is, perhaps advantageous, as it facilitates the work and possibly decreases the losses; but any theoretical scale as now employed or advocated for screens is of no value.

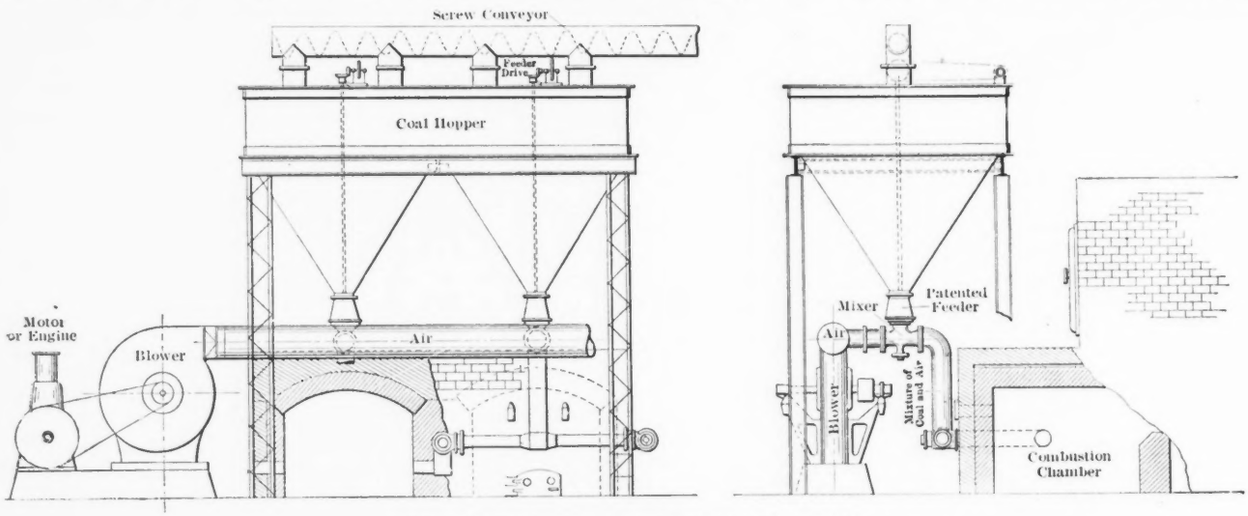
In determining the proper classification when treating a combination of minerals of very small difference in specific gravity, the following method can be used: The unclassified ore is fed into a machine arranged for the coarser grains, i.e., with long stroke, medium speed, and bed so coarse that the largest grains pass through. After repeated tests, the machine is finally set for as pure concentrates as possible. The fine grains in the concentrates thus obtained are leanest in metal and lower the average percentage. They are screened out and a new test is made with them on another machine arranged so that the coarsest of these will pass through. The concentrates now obtained are treated as before and the jigging of the finer grains is repeated until a class of grains in which the finest can be included has been obtained, or if that is not possible, they can be classified by water classifiers and treated on tables.

The screen scale determined in this way is regulated by the specific gravity of the minerals, and all the factors which in the working of the machine have a direct influence on the result. At the same time, the percentage of metal desired in the concentrates can be obtained, which is a good deal more than can ever be done with any theoretically calculated screen scale.

All this, however, is of little use except when treating mineral combinations with very little difference in specific gravity. If the difference is great, as, for instance, between iron ore and gangue minerals, how the classifying is done is immaterial.

Coal-dust Firing for Boilers

According to *Power*, a new device for coal-dust firing in connection with steam boilers has been introduced by the International Combustion Corporation, of Buffalo, N. Y. The device, which is illustrated in the accompanying engraving, is very simple. The coal is ground to 40-mesh and conveyed in any convenient manner to a hopper, to which is attached a patent feeding device. The coal in passing through the feeding apparatus is mixed with air at a pressure of about 4 oz. and blown directly into the furnace through two ordinary wrought-iron pipes, or sheet-steel opposed pipes. No air is taken into the furnace whatever, except through the feeding pipes with the coal.



TYPICAL INSTALLATION OF PULVERIZED-COAL BURNER

Swedish Iron Production

According to a summary published in *Stahl und Eisen*, the iron production of Sweden during the last two years has been as follows, in metric tons:

	1906.	1907.	Changes.
Pig iron	112,200	129,800	I. 17,600
Castings	16,200	11,700	D. 4,500
Blooms and billets	40,600	42,300	I. 1,700
Bars	200,600	160,800	D. 39,800
Rolled shapes	6,300	23,700	I. 17,400
Sheets	2,900	2,300	D. 600
Pipes and tubes	13,900	18,800	I. 4,900
Wire	2,700	2,900	I. 200
Nails	5,900	7,200	I. 1,300
Total	401,300	399,500	D. 1,800

These figures give the forms in which products were sold by various works. The production of iron ore in 1907 was approximately 3,500,000 tons.

The Jackson Method of Tailings Disposal

SPECIAL CORRESPONDENCE

Stamp-mill practice in the Michigan copper country requires the use of large quantities of water, from 15 to 32 tons of water per ton of rock treated. It is largely for this reason that the mills are located on the shores of Lake Superior and its tributary waterways. The accompanying average screen test will give a general idea of the quality of the tailings leaving the different concentrators, treating the amygdaloid rock.

SIZE OF LAKE SUPERIOR COPPER MILL TAILINGS

Size Mesh	Per Cent.
On 3/16	7
On 10	21
On 20	17
On 40	16
On 60	3
Through 60	36

At several of the stamp mills these tailings have been conveyed in launders with a drop of about ¼ in. per foot, or 2.08 per cent., and allowed to discharge into the lake, until the sand banks have reached such a hight that the launders cannot be given sufficient drop to convey the material through them.

The problem of disposing of the tailings when this condition has resulted, has been solved in various ways by local engineers. The different methods may be briefly described as follows:

(1) Centrifugal pumps handling the total tailings in relays, thus by several handlings conveying the material a sufficient distance from the mill. This scheme has been used only as a last resort, because of the excessive costs for maintenance and power.

(2) Sand or raff-wheels. At one of the stamp mills two mammoth wheels, 50 and 60 ft. in diameter, are daily elevating about 8000 tons of sand and 120,000 tons of water, in the buckets attached to their inner perimeters. The material, discharging from the top, runs by gravity, through launders to the waste pile. These wheels consume from 600 to 700 horsepower.

(3) Centrifugal pumps, handling the fine material and water from the slime department and elevating it to a hight sufficient to catch the rough jig tailings, the mixture flowing from the mill by gravity in the usual way. This scheme consumes less power and the wear on the pump linings is much less than when the total material is handled by centrifugal pumps.

PERFORATED BUCKET ELEVATOR AND CONVEYER

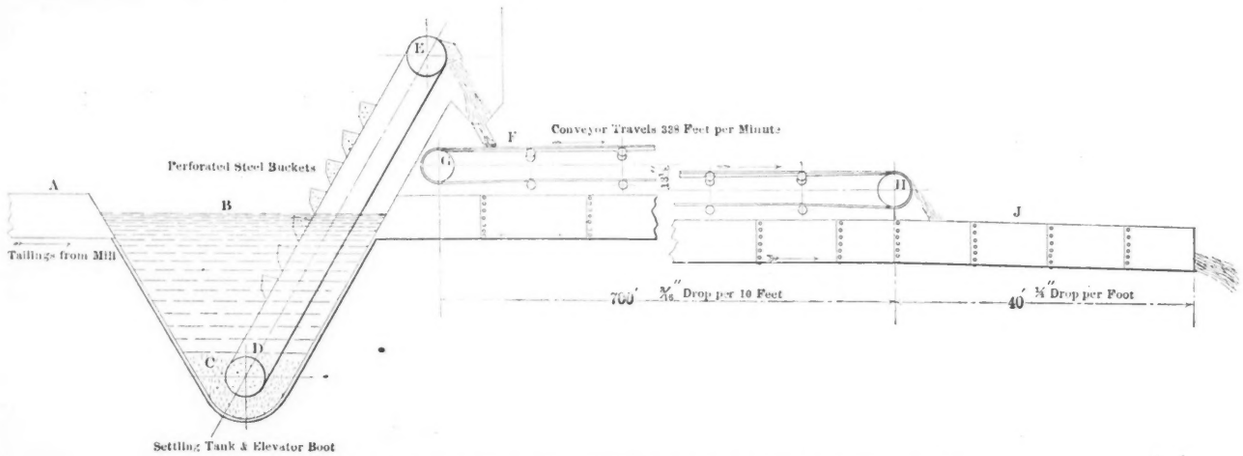
The latest solution of the problem was first proposed by J. F. Jackson, resident engineer for the Wisconsin Bridge and Iron Company. The method has been installed by the Mohawk Mining Company at its stamp mill on Traverse bay, where it has been in successful operation for some time. The following description with the accompanying diagram will serve to give a general idea of the installation.

The tailings are conveyed from the mill in a launder which has ¼-in. per foot drop, to a large settling tank about 80 ft. distant. The sand, amounting to 2000 tons per day, settles to the bottom of this tank and drops into the boots of four bucket elevators, which elevate it to the desired hight. The buckets are made of perforated steel and are 24 in. long, 14 in. wide, and 13.5 in. deep. They are attached to a link-belt traveling from 30 to 35 ft. per minute and operated by a 2.5-h.p. direct-current motor.

The sand is discharged into a hopper which distributes it on a traveling-belt conveyer. This conveyer is an eight-ply rubber belt, 20 in. wide, 1400 ft. long, traveling on troughing-roll carriers at the rate of 338 ft. per minute.

The water, amounting to 64,000 tons per day, flows from the top of the settling tank in two launders, each 30 in. wide and 14 in. deep, and discharges into a semi-circular steel launder 52 in. in diameter. This semi-circular launder is 740 ft. long, or 40 ft. longer than the sand conveyer; the first 700 ft. has a total drop of but 13⅛ in., or 0.16-per cent. grade, which is sufficient to convey the water through it. The sand is discharged from the belt conveyer into this launder which has, from this point to its end, a drop of ¼ in. per foot. Thus the total tailings, sand and water, are caried a distance of 740 ft. with a drop of 13⅛ in., and a total consumption of 25 h.p. It will be noted that the net saving in hight at the end of the launder over the ordinary run of ¼ in. per foot is the difference between 175 in. and 13⅛ in., or 13 ft. 5⅞ in. A conveyer 2100 ft. long would therefore give results equivalent to elevating the total tailings 40 ft. by means of sand wheel or pumps, and would require but the slight addition of power to operate the longer conveyer.

Other points of advantage of this system may be enumerated as follows: (1) Distribution of tailings; after the sand has been conveyed a sufficient distance from the mill it is again mixed with the water, thereby getting a simple and efficient means of distributing the tailings at the end of the launder. (2) Separation of sand and water; there being about 30 tons of water per ton of sand, it will be seen that the size of the machine, initial cost, and horse-power have been very greatly reduced. (3) Wear on semi-circular launder; this launder for 700 ft. carries only water and very fine slime; hence the wear is almost nothing.



DIAGRAMMATIC ELEVATION OF JACKSON'S PLANT FOR DISPOSAL OF TAILINGS

Miners' phthisis, or silicosis, is caused by particles of dust breathed into the lungs. Possibly, as some contend, gases from the exploding dynamite and other causes aggravate the conditions; but the chief cause of the disease appears to be rock particles, for autopsies in many cases have shown dust particles at the center of diseased areas in the lungs. The weakened lungs later fall an easy prey to consumption or pneumonia germs so that finally one of these diseases appears to be the main cause of death.

The Seven Troughs Mining District

By William M. Hauck*

The Seven Troughs mining district is situated in the Stonehouse range, which is west of the Trinity range, in Humboldt county, Nevada, about 26 miles northwest of Lovelocks, a station on the Southern Pacific railroad. The name is derived from the seven watering troughs, which were built by the stockmen to supply water for the stock which ranged in the vicinity during the winter. These troughs gave the name Seven Troughs cañon to the place; consequently the mining district is now called by the same name.

PART OF VERNON, NEVADA. VERNON PEAK IN BACKGROUND

These watering troughs are located near the center of the district which is about 20 miles long and 10 miles wide. As the ore occurrences throughout the district are scattered, several towns have sprung up near the points where the more important properties are situated. Near the troughs is the town of Seven Troughs, which is a typical mining community composed of a few hundred inhabitants. About a mile east of Seven Troughs is the town of Mazuma; about eight miles north is the town of Farrell, while about three miles south of Seven Troughs is Vernon. At Vernon there are stores, hotels and a bank. The stage fare from Lovelocks to Vernon is $5, one way; the automobile fare is $7.50 to $10.

The mineralized area of the Seven Troughs district appears to be a belt of yellowish porphyry, about 12 miles long and several miles wide, which has been intersected by many dikes. The rock of some of these dikes is rhyolite, in others a black volcanic glass, and in still others a basaltic rock. The ore is found along these dikes.

Near the surface the ores are oxidized, but with depth sulphides are found. In the sulphide zone the gold occurs generally associated with pyrite. At depth, in some mines, ruby-silver ore is found together with native gold containing very little silver. At one mine it is reported that in depth a vein of stibnite, 6 to 12 in. wide, has been cut by one of the drifts. In another mine traces of tellurium have been found in the ore which is very silicious. The gouge generally assays well. The talc in the vein and sometimes calcite, which occasionally is found in the vein, often pan well. A white sugary quartz generally assays the highest.

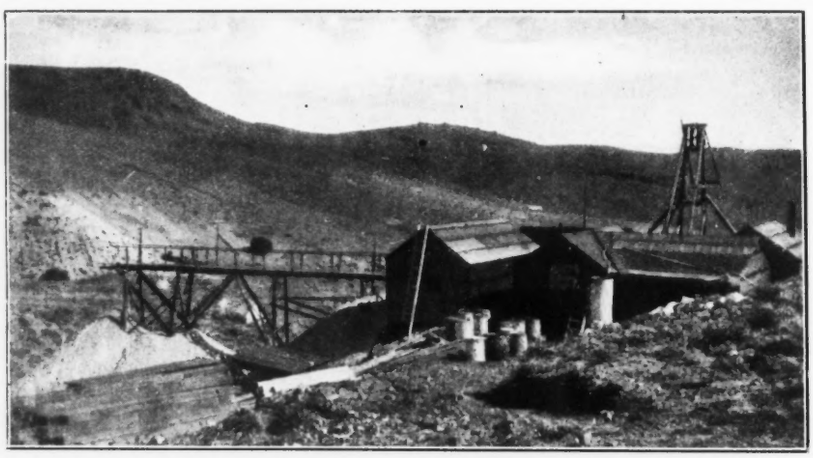
The district is mountainous but water is scarce. The vegetation consists mainly of sagebrush with a few juniper trees scattered here and there.

Provisions are comparatively costly. The price at Vernon, a short time ago, of some supplies was: Ham, per lb., 19c.; bacon, per lb., 21c.; eggs per doz., 40 to 60c.; butter, 2-lb. cans, $1; tomatoes per can, 15c.; fruit per can, 25c.; sugar per lb., 9 to 10c.; flour per cwt., $4.25 to $4.50; onions per lb., 6c.; potatoes per lb. by sack, 3½c.; bread per loaf, 15c., two loaves, 25c.; blacksmith coal per lb., 3c. Freighting into the district costs 1½ to 2c. per lb. The freight charge on ore to Lovelocks is ¾c. per lb. Domestic coal, in one instance, cost delivered at the mine $35 per ton, the freight was 1c. per lb. Water sells at 5c. per gallon. Miners' wages vary from $4.50 to $5 per eight-hour shift. Meals at restaurant cost 50c.; lodging, $1 per night.

Midway between Seven Troughs and Vernon, the Fairview mine is situated; nearby are the Delaware and Gold Prize groups, while farther east is the Boilermaker group.

The Fairview shaft is 500 ft. deep and from it more than 500 ft. of drifts and crosscuts have been driven, most of which are in ore. On the lower levels some ruby silver ore is found. The shaft is equipped with a 15-h.p. gasolene hoist while a 3-h.p. gasolene engine drives the blower and a dynamo, used to furnish electricity for lighting. Drilling is done by hand.

The Fairview mine is preparing a shipment of 10 tons of ore, which is expected to be richer than the ore composing the famous shipment mined from the Hayes & Monnette lease on the Mohawk mine at Goldfield. This estimate of the richness is not unreasonable in view of the statement of Mr. Ellithorpe, manager of the mine, that specimens had assayed from $100,000 to $200,000 in gold and silver per ton; besides, John R. Magill, an assayer of Vernon, stated that he had assayed a sample which gave $120,000 per ton.



SEVEN TROUGHS MINE, HUMBOLDT COUNTY, NEVADA

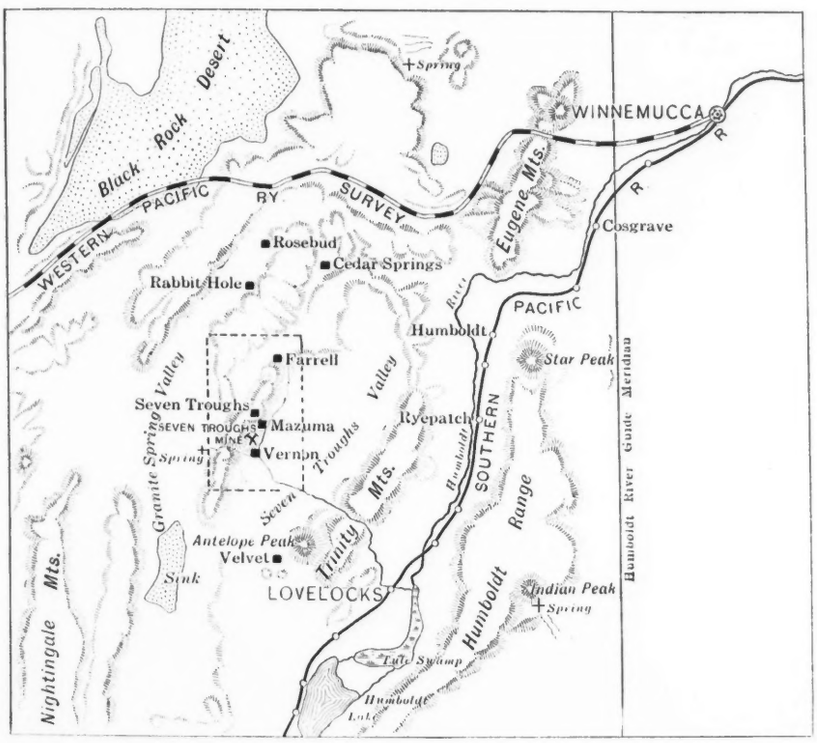
The Fairview company has acquired water rights in the cañon and is planning to erect a mill at Seven Troughs. Near Seven Troughs are the Mazuma Hills mine, belonging to the Mazuma Hills Mining Company, and the Kindergarten mine, belonging to the Kindergarten Mining Company; also several promising prospects. Several shipments of high-

*Mining engineer, 223 East Eighty-seventh street, New York.

grade ore have been made from the Mazuma Hills mine, but the smelter returns have not been published and no visitors are permitted to enter the adits or workings of the company.

At the Kindergarten mine, ore has been sacked and is being stored in the drifts awaiting shipment. This company is under the same management as the Fairview mine, but it is owned by a separate company.

Near Vernon are several good prospects, the most promising of which is the Buckhorn group. Near Farrell some rich ore has been found. Mr. Kimball and associates have discovered a lode near there, which is 5 ft. wide at the surface, but this increases in width with depth.



SEVEN TROUGHS MINING DISTRICT, HUMBOLDT COUNTY, NEVADA

John R. Magill, the assayer, took samples across this width which averaged $250 per ton.

The district as yet is not developed enough to enable much of a study to be made of the orebodies at depth, but at present the camp is very promising.

Transvaal Mining Notes

SPECIAL CORRESPONDENCE

The news from Potgietersrust, the center of the government tinfields, is rather encouraging, as payable tin ore is being found. It is rumored that the Government is so encouraged by the outlook that a mill will be erected. Meantime the richest ore will be shipped, there being about 60 tons of high-grade stuff now ready for export. The health of the camp is good, and the men are proud of the fact that the camp is "white," there being only four Kafirs in the place, and they declare this experiment proves that this country can be a white man's country from the Cape to the Zambesi.

An annual meeting of very great interest was that of the Randfontein Estates, Ltd., a large corporation with mines on the West Rand. During the year under review there were four gold-producing properties, which obtained the following aggregate results: 400 stamps, supplemented by two tube mills, ran 346,245 days, crushing 742,465 tons of ore, which yielded in fine gold 288,024 oz. The value of the gold, together with sundry revenue derived from other sources, was £1,215,914, equal to $7.86 per ton milled, and the cost of production was £868,293, equal to $5.62 per ton milled, leaving a profit of £347,622, or $2.24 per ton milled. Each of the four companies declared a dividend for the year at the rate of 10 per cent. Development and construction work was actively carried on upon all of the non-producing companies of the group, six in all.

The working costs at the Randfontein certainly do not strike one favorably, but perhaps there are adverse conditions which account for it. This is one of the cases on the Rand where consolidation would be a wise policy. All the ground is under one control, and were the 400 stamps under one roof, instead of four, it would make for efficiency. No doubt the policy of consolidation will be adopted for the new mines, and a huge central mill will be built. The outlook for the Randfontein Estates is bright, provided sufficient capital can be raised for future expansion. This corporation does not appear to be popular with the investing public.

The January returns show that the labor position is quite satisfactory, the deported Chinese being replaced by Kafirs. It must be remembered, however, that the dull times in South Africa are forcing thousands of extra Kafirs to the Rand. If prosperity returns these will be absorbed in other lines, or else remain at home.

The Simmer & Jack takes premier place for January over the Robinson; the first-named mine produced gold valued at £107,820, while the Robinson was second with gold valued at £107,485. Third on the list was the Robinson Deep, the value of the gold being £87,469.

What is known as the "Asiatic trouble" on the Rand has been satisfactorily settled by a compromise. The educated Asiatics will not be forced to give their finger prints when registering, their signatures being sufficient. No coolie will be forced to give his finger prints if it is against his religious convictions. The compromise is fortunate, for a very ugly situation would have occurred had the law been enforced and the Asiatics remained obdurate.

Surface Rights and Mining in Ontario

Hon. Frank Cochrane, minister of lands and mines, of Ontario, has introduced in the provincial legislature, a bill amending the Public Lands act, which provides that when lands, not valuable for their mines, ores or minerals, but suitable for agriculture, are thrown open for settlement the settlers shall be entitled to the minerals which subsequently may be found therein. The measure has a retroactive effect, and enacts that all reservations of mines and minerals in patents heretofore issued—where such mineral rights are the property of the Crown and have not been granted under the Mines act—are rescinded, all minerals passing to the owners of the land. In future, no townships will be open for settlement until they have been carefully examined and their suitability for settlement assured; the settler will have the benefit of any minerals thereafter discovered. This measure will remove a long standing grievance and cause of dispute between settlers and mining men. The holders of the surface rights to land, not known to contain minerals at the time of location, especially in oil- and gas-producing areas, have been subjected to disturbance by parties subsequently obtaining mining rights.

Liberty Bell Gold Mining Company

The report of the Liberty Bell Gold Mining Company for the year ending Sept. 30, 1907, is a good one and leaves little to be desired by the stockholders in the way of information regarding their property. Arthur Winslow, general manager, remarks as follows:

"The receipts per ton milled were 87c. less than during the preceding year while the percentage of recovery shows an increase of only 2 per cent., though the saving on silver was raised from 40 to 48 per cent. The profit balance of $81,805 plus the depreciation fund which was not expended, makes a total of about $107,000. Of this, the sum of $38,328 was applied to construction and equipment and the purchase of new mining property; $45,400 was applied to the retirement of bonds; and $19,583 was distributed in dividends."

Complete tables of costs are given, but the gist of them is contained in the accompanying table.

The grand total mined since the beginning of operations in 1899 has been 510,729 tons. The amount estimated in sight Sept. 30, 1907, is given at 420,000 tons, making a total mined and in sight of about 930,000 tons. The development work was as follows: Drifting, 15,676 ft.; crosscutting, 599 ft.; tunneling, 3183 ft.; raising, 830 ft.; sinking, 158 ft.; total, 26,446 ft. Thus it appears that one foot of opening developed about 35 tons of ore.

The accompanying drawings give a section of the mine showing progress of development; and a section of the Stilwell tunnel. In calculating the ore in sight and the probable ore, the width of vein is assumed at 3.4 ft., the average of nine years; one dry ton in solid, 13 cu.ft. The distance between Stilwell tunnel and No. 1 level is 964 ft. The ore below the tunnel is not estimated.

Besides the ore described as being in sight, probable ore is estimated at 1,435,000 tons and the total possible ore above the Stilwell tunnel at 2,455,000 tons. It would appear from this that the managers expect the mine to last from 18 to 25 years at its present rate of production. A table shows the ore proceeds in detail. It appears that in 1907, the amount realized from stamp bullion was $4 a ton; from concentrates 64c. and from the cyanide mill $2.45 per ton. The total contents of the ore was 0.297 oz. gold and 4.63 oz. silver per ton. The total saving effected was 91 per cent. of the gold and 48 per cent. of the silver.

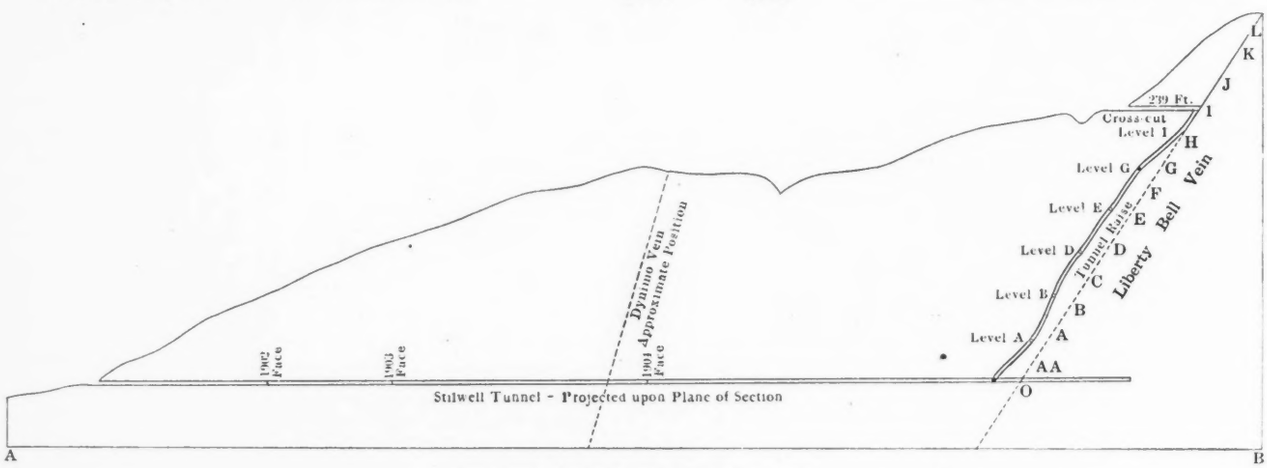
The total dividends paid by the company have been only $130,440. The total amount earned is described as $520,212. Mr. Winslow says that of these earnings $286,000 have been put back into the property and charged to construction and property account. Nothing is said as to the probability of further construction being necessary.

STATEMENT OF OPERATIONS, LIBERTY BELL GOLD MINING COMPANY.

	Total Cost.	Cost per Ton. 1907.	Cost per Ton. 1899–1907.
Expenses:			
General expenses (102,104 tons)	$72,182	$0.71	$1.05
Mining (102,429 tons)	260,413	2.54	2.65
Development (5783 ft.)	54,718	.53	2.65
Tramming (102,229 tons)	34,145	.33	.42
Milling (102,104 tons)	211,229	2.07	1.70
Treatment and shipping costs:			
Stamp bullion (62,291 oz.)	1,733		
Concentrates (1,415 tons)	21,217		
Cyanide bullion (120,095 oz.)	3,368		
Total operating expenses	$659,005		
Average cost per ton milled		$6.44	$6.34

	Total.	Receipts per Ton. 1907.	Receipts per Ton. 1899–1907.
Receipts:			
Ore proceeds (102,104 tons):			
Stamp bullion	$413,310	$4.04	$4.63
Cyanide products	249,909	2.45	1.60
Concentrates	65,041	.64	.96
Boarding house profit	5,251		
Receipts from tram	4,674		
Profits from mine commissary	2,548	.12	.15
Rentals and sundries	77		
Total Receipts	$740,810		
Average receipts per ton ore milled		$7.25	$7 34
Balance profit	$81,805.37		
Per ton milled profit		$0.80	$1.00

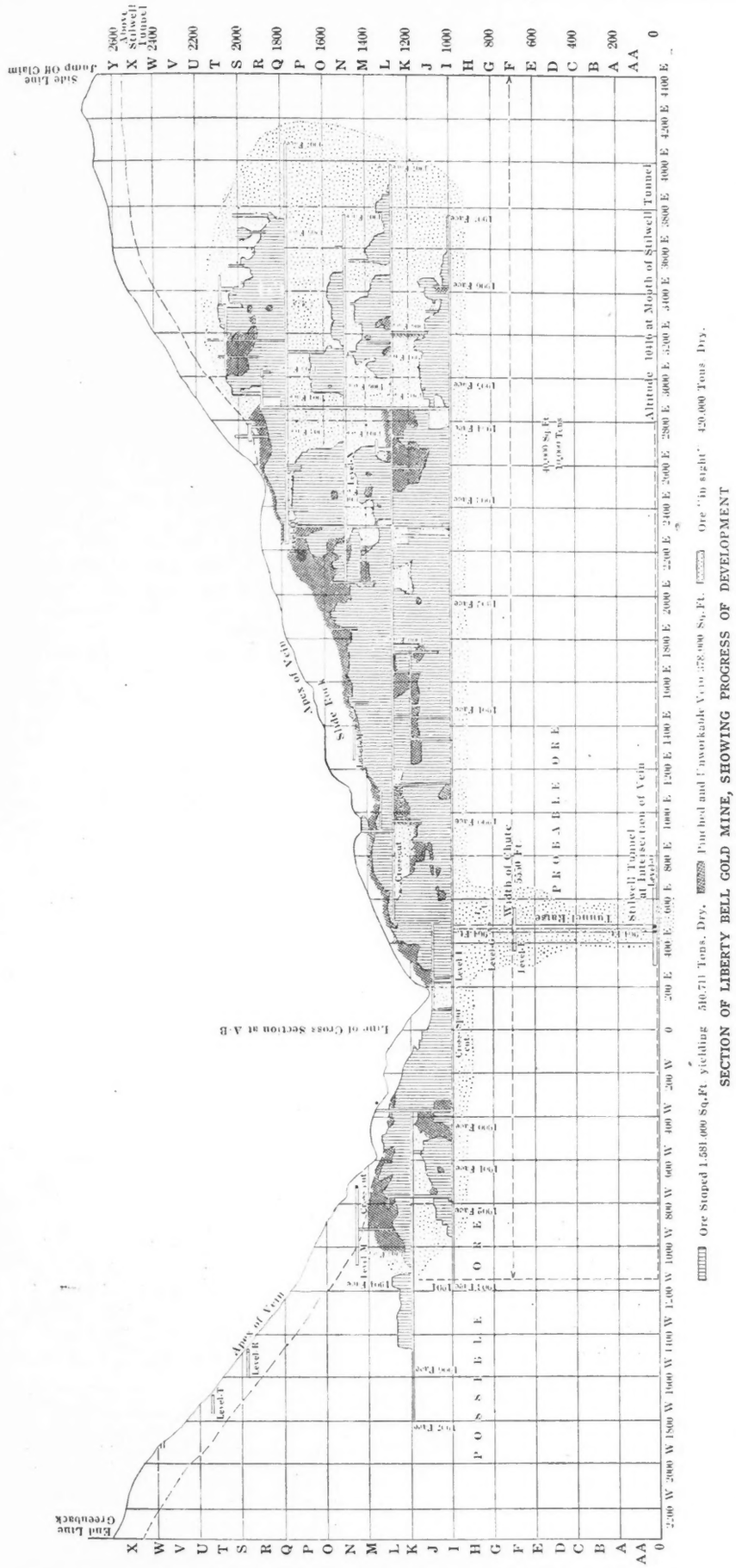
The advantages of resuing are that, although the cost of mining is higher than it would be if the ore and waste were broken together, the richness of the ore sent to the mill is increased and the waste rock is left in the mine as filling so that pillars of ore do not have to be left to support the wall of the stope. This filling of the stopes make the mine safer and has a far-reaching effect on subsequent mining in other parts of the mine. The smaller tonnage sent to the mill decreases the milling costs, increases the capacity of the mill, and causes a greater saving of ore as there is a smaller proportion of tailing produced and consequently less loss of ore in the tailing.



STILLWELL TUNNEL, LIBERTY BELL MINE

A chain and bucket dredge designed to raise 600 tons of material per hour from a depth of 66 ft. below water level is stated in London *Engineering* to have been completed last summer for harbor work at Rio de Janeiro, Brazil.

S. W. Parr recommends standardizing all lots of sodium peroxide which are to be used in determining the calorific power of coal by a combustion bomb, as this substance has been found to vary widely in its oxidizing power.



SECTION OF LIBERTY BELL GOLD MINE, SHOWING PROGRESS OF DEVELOPMENT

Ore Stoped 1,581,000 Sq.Ft yielding 510,711 Tons, Dry. Pinched and Unworkable Vein 578,000 Sq. Ft. Ore "in sight" 420,000 Tons Dry.

Guggenheim Exploration Company

The report of the Guggenheim Exploration Company for the year ended Dec. 31, 1907, shows the following financial statement:

Assets:	
Treasury stock	$ 1,673,700
American Smelters Securities Co. (A)	13,860,000
American Smelters Securities Co. (B)	1,800,000
American Smelters Securities Co. Common	1
Other Properties and Investments.	17,564,989
Furniture, Fixtures and Equipment	7,706
Bills and Accounts Collectible	4,449,976
Cash	541,390
	$39,897,762
Liabilities;	
Capital Stock	$22,000,000
Bills and Accounts Payable	4,153,510
Surplus	13,744,252
	$39,897,762

The detail of "Other properties and investments" is made up of the following items: Cumberland-Ely Copper Company, $912,808; Esperanza, Ltd., $426,183; Nevada Consolidated Copper Company, $1,671,589; Nevada Northern R. R. Co. Bonds, $1,650,000; Utah Copper Company, $4,632,283; Yukon Gold Company, $8,222,106; Miscellaneous investments, $50,020; total, $17,564,989.

All of the above items, excepting "miscellaneous investments," are carried at cost. Pacific Gold Dredging Company, Atlin Consolidated Mining Company, Yukon Consolidated Gold Fields Company, Bullion Hydraulic Mining Company, and Cariboo Gold Mining Company, shown in the last annual statement, have all been merged into the Yukon Gold Company.

President Daniel Guggenheim says: "We believe the stockholders have every reason to feel gratified with this statement, considering that none of the properties enumerated above, with the exception of Esperanza Ltd., has been upon a dividend-paying basis up to the present time.

"Now, however, in the opinion of our engineers, the development and equipment of the Utah Copper Company, Nevada Consolidated Copper Company, Cumberland-Ely Copper Company and Yukon Gold Company have progressed so far as to assure the earning of dividends during the year 1908."

The quantity of crude oil delivered to Rumanian petroleum refineries during the first nine months of 1907 amounted to 698,740 tons, against 567,835 tons in the corresponding period of 1906, and 366,287 tons in 1905.

Any fuel can be burned without smoke provided that it is mixed with the proper amount of air at the proper temperature. The difficulty is to accomplish this under power-plant conditions.

Delaware, Lackawanna & Western Company

This company, besides a railroad system extending from New York to Buffalo and Oswego, owns extensive coal properties in the Wyoming district of the anthracite coal region of Pennsylvania. Unlike most of the anthracite-carrying roads, the company operates its coal property directly, and not through the medium of an auxiliary or controlled corporation. The report of the Coal Department for the year 1907 gives some interesting figures in relation to costs and results of operation.

The coal statement for the year is as follows:

	1906.	1907.	Changes.
Coal on hand Jan. 1	655,924	602,939	D. 52,985
Coal mined and bought	9,152,743	10,371,341	I. 1,218,598
Total	9,808,667	10,974,280	I. 1,165,613
Sold at mines	113,216	106,865	D. 6,351
Railroad use	1,476,334	1,672,237	I. 195,903
Local agencies	5,300,377	6,199,942	I. 899,565
Foreign agencies	2,315,801	2,405,147	I. 89,346
Total sales	9,205,728	10,384,191	I. 1,178,463
On hand, Dec. 31	602,939	590,089	D. 12,850

The income statement for the year 1907 is given below. Averages are calculated on the number of tons set opposite each item, general expenses, improvements and taxes on total tonnage sold. The tons are long tons, of 2240 lb., as usual in the anthracite trade:

Coal sales:	Tons.	Amount.	Per Ton.
At mines	106,865	$ 271,641	$2.54
Company's supply	1,672,237	1,762,475	1.05
Local agencies	6,199,942	22,796,731	3.68
Foreign agencies	2,405,147	15,219,756	6.33
Total sales	10,384,191	$40,050,603	$3.86
Barge earnings	975,901	245,686	0.25
Increased value of coal on hand	.....	74,431	....
Total	10,384,191	$40,370,720	$3.89
Coal mined and bought	10,371,341	$16,752,181	$1.62
Transportation, D. L. & W. lines	8,577,354	14,460,329	1.95
Transportation, other lines	2,506,473	1,970,832	0.78
Selling agencies	8,388,980	942,891	1.12
Commissions	2,282,831	439,508	0 19
General expenses	.....	151,730	0.01
Vessel expenses	975,901	218,816	0.22
Improvements	.....	783,912	0.08
Taxes	.....	425,600	0.04
Total expenses	10,384,191	$36,145,799	$3 48
Net earnings	10,384,191	$ 4,224,921	$0.41

Generally classified, the cost of coal sold was made up as follows: Mining, $1.62; transportation, $1.60; selling, $0.13; general expenses, $0.13; total $3.48. The expenses were 89.5 per cent. of the gross earnings.

The coal traffic report of the railroad shows: Long tons carried, 9,425,498; ton-miles, 1,693,486,758; average haul, 180 miles; average earnings per ton, $1.52; average rate per ton-mile, 0.848c. The rate per ton-mile shows a decrease of 0.025c., or 2.9 per cent., from 1906. The rate per ton-mile on coal was 0.166c. higher than that on general freight. Mineral products, other than anthracite coal, carried were, in short tons: Bituminous coal, 948,156; coke, 204,404; iron and other ores, 350,407; stone, sand, etc., 618,079; lime and cement, 292,817; pig iron, 486,676; finished iron and steel, 533,722 tons. Anthracite coal was 50.5 per cent. of the total tonnage moved; other mineral products, 16.3 per cent.

President W. H. Truesdale says, in his report: "The company's mines and washeries were run to their full capacity throughout the year. Several of the more important collieries were shut down for some months undergoing extensive repairs. This, however, occurs each year with some of the collieries and cannot be considered out of the ordinary. The demand for all sizes of coal produced was urgent throughout the year; in fact, at no time was the company able to fill its orders entirely and stock of coal on hand at all points at the close of the year was about 13,000 tons less than at the beginning. This is remarkable in view of the fact that the total production of anthracite coal during the year was greater by several million tons than any previous year in the history of the industry. This is also significant as indicating that the growth of the demand for this fuel has practically reached the possible supply thereof. In this situation may be found, and nowhere else, all there is to the so-called 'Anthracite Coal Trust' about which so much misinformation has been written and given to the public through various channels in recent years, as applied to the large anthracite coal producing interests of the country.

"This company's mining operations have been successfully prosecuted throughout the year without serious accidents or casualties of any kind. Notwithstanding the large production, the mining cost per ton has increased and is higher than in any previous year. This company's showing in this regard is the same as that of other large producers. For the reasons given in previous reports the mining of anthracite coal becomes increasingly difficult and expensive each year. This company, moreover, is now making special efforts to mine as many of the thin so-called surface veins of coal as it possibly can. It is also endeavoring to open up some of the old caved and abandoned workings in order to get any coal that can be saved therefrom; also it is working more of the lower thin veins of coal than hitherto. Generally speaking, the policy of the management is, in view of the limited deposit of anthracite coal, to make every possible effort to work out and market every ton of it that can be won at anything less than a prohibitive cost. During the year about 400,000 tons of coal have been mined from the surface veins and old workings, which, until very recently, it has never been thought available to mine.

"Much work in the nature of improvements to the company's mining properties has been done during the year. Much of the work consists in the further installation of electrical appliances of various kinds. The large expenditures for additions to Hampton Central steam plant and electric power station are of this character. Other important work may be mentioned, as the completion of a new breaker for Diamond colliery, and the sinking of new air shafts at Hyde Park and Woodward collieries. Work was also begun on an entirely new operation, which will be opened up during the next two or three years. The general condition of the company's collieries, washeries and appurtenant structures and appliances is better than at any time in recent years.

"The miners and employees generally in and about the company's mines are prosperous and content. No disputes or troubles have arisen during the year which have not been promptly and readily adjusted by the officials of the company without friction or resort to the Board of Conciliation, formed several years ago by the award of the Anthracite Coal Commission. The company's officials cannot now conceive of any reason why the existing cordial relations between the company and its mine employees should not continue indefinitely.

"The entire anthracite industry is certainly on a very stable, healthy basis; one that should be satisfactory to all interests concerned and one which, from the standpoint of the public, should be continued indefinitely. Few of those who are so ready to criticize this, with other large property interests, know that the prices of domestic sizes of anthracite coal realized by the producers thereof during the past year are exactly the same as those fixed after the great strike of 1902. All other staple commodities which comprise the necessities of life have been advanced in price again and again until they reached the maximum of recent years in the early months of 1907, the price of anthracite coal meanwhile remaining as in 1902. In this may be found one of numerous sound and convincing reasons why this prime necessity of life should remain in the control of the comparatively few hands where it now is.

"The outlook for 1908 as respects the coal business of the company is promising, and there is no present indication that it will suffer to the extent that general business seems to have been affected by the financial troubles of the country during the closing months of 1907. Certain it is that thus far the anthracite industry is much less embarrassed by these troubles than any other important one."

The use of calcium chloride in refrigeration is rapidly increasing, especially because it does not attack the iron pipes as does a solution of common salt, and also because it possesses a lower freezing point.

The Dwight and Lloyd Sintering Process

A New Blast-roasting Process in Which the Material is Sintered Continuously in Thin Layers and Giving a Peculiar Cellular Structure

BY ARTHUR S. DWIGHT*

The metallurgical treatment of fine material, particularly fine sulphide concentrates is a problem which is pressing more and more heavily upon the metallurgist. Most of the copper now produced in the West comes from extensive low-grade ore deposits that can be cheaply mined and concentrated. The blast furnace has an unquestioned superiority over the reverberatory when the material to be smelted can be supplied to it in reasonably coarse form, but with fine ores and concentrates it is at a positive disadvantage, and for the reasons above mentioned many metallurgists have been almost convinced that the return of the reverberatory into preeminence was inevitable. The development of the Montana type of reverberatory furnace of large capacity has been indeed remarkable and reflects great credit upon the metallurgical skill of the engineers who have been responsible for its success.

The Dwight & Lloyd system of sintering fine materials is the result of a serious and oft-repeated effort to devise a workmanlike method which would be a satisfactory and economical substitute for roasting and briquetting, in the treatment of fine material such as concentrates, pulverulent ore, flue dust, etc., in preparation for blast furnaces. The metallurgical and commercial results that have already been attained in the development of this process are decidedly satisfactory and it has now been working under daily operative conditions long enough to establish its reliability and average cost factors. Indeed, it looks as though a practical and economic solution of this very vexatious question has been found which may restore, to some degree, the prestige of the blast furnace.

A Blast Roasting Process

The process may be considered as coming within the class of those, which for lack of a concise term may be designated "blast-roasting processes," that is, those which involve the use of controlled air currents. In the same class, generally considered, are the well-known Huntington-Heberlein, Carmichael-Bradford, and Savelsberg processes, which have come forward very prominently in the metallurgical practice of the last few years. These methods were devised originally for the treatment of lead sulphide ores, but it has been shown that copper ores are equally adaptable.

The effectiveness of an air blast in hastening roasting has long been recognized, but the very rapidity of the reaction defeated its own ends, for the sulphides quickly melted together, and impeded further oxidation. Huntington & Heberlein found that they could prevent this premature matting of the sulphides by mixing lime with the charge, just as had been done for generations in the old Flintshire lead practice. The particles of lime served to keep the particles of galena separated during the oxidizing period, thereby favoring individual-roasting of the sulphide particles, as distinguished from mass-roasting. Until this precaution was observed, blast roasting never had a chance to show what it could do, and the first time the partially roasted charge so prepared was transferred to the converter and treated with an air blast, the remarkable possibilities of roasting in that way must have become apparent. But in order to account for the astonishing results, it seemed for a time necessary to assume the existence of compounds and reactions of lime heretofore unsuspected or considered as impossible.

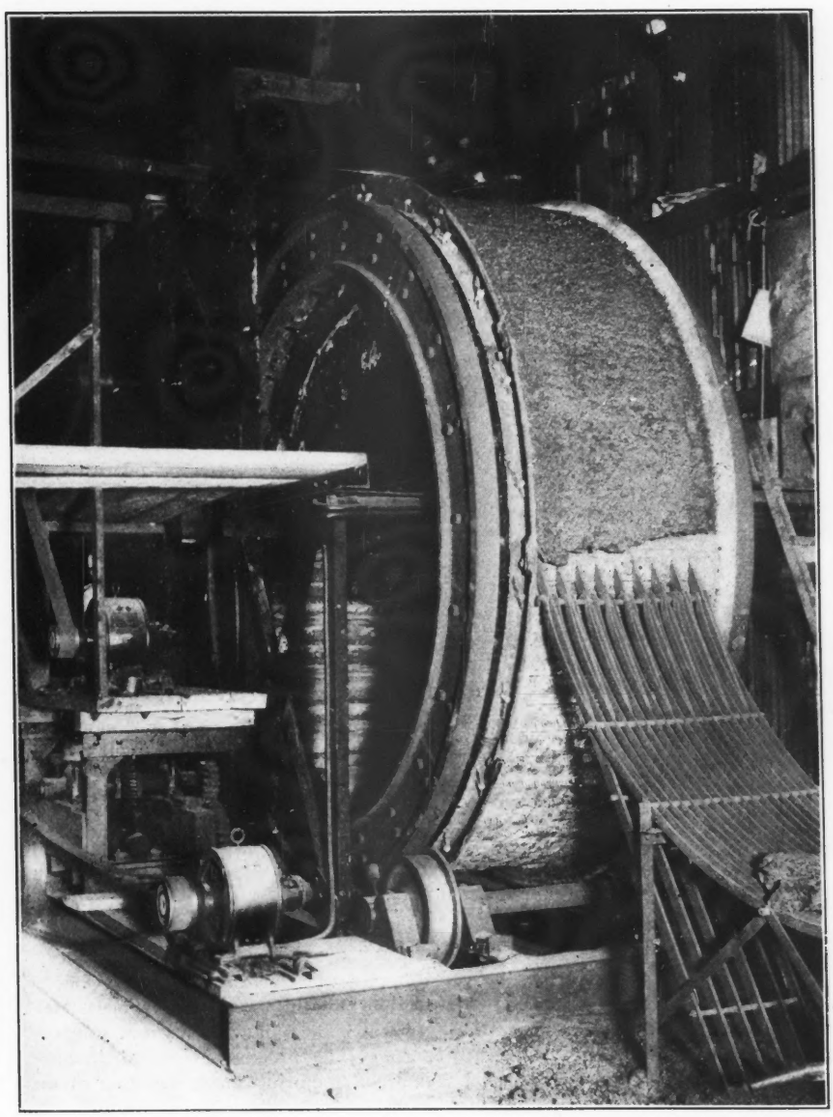


FIG. 1. DWIGHT & LLOYD SINTERING MACHINE, DRUM TYPE, SHOWING STRIPPING GRIZZLY

Principles of Lime Roasting

These assumptions were widely dis-

*Mining engineer, 25 Broad street, New York.

cussed and largely accepted. Careful research, however, proved them to be fallacious. Now, it is quite satisfactorily established that the function of the lime is mechanical rather than chemical, and a brief statement of the principles involved would be as follows: Make up a charge in which sulphides are mixed with other ingredients, so chosen that during the first or roasting period they shall remain more or less inert, acting as isolators to prevent mass-action among the burning sulphide particles, but which subsequently, during the second or agglomerating period, shall be capable of uniting with the metallic oxides produced by the roasting, and with the other ingredients of the charge to form silicates, or other compounds which will become sufficiently viscous at the temperatures developed by the reactions to cement the mass together more or less into what we call a sinter.

The Huntington-Heberlein procedure still uses the reverberatory furnace for the preliminary roasting. The Carmichael-Bradford and Savelsberg procedures generally perform the entire operation in the one converter, and both plans are justified by special conditions of the problem.

The results achieved by Huntington & Heberlein in building up, by a combination of old and almost discarded metallurgical methods, a practically new process, and making it a brilliant commercial and technical success deserve the highest commendation and praise. It unquestionably marks one of the real advances in the metallurgy of lead and copper in this generation and has been largely adopted by lead smelters in all parts of the world.

Defects of the Blast-pot

It must be conceded, however, that even the best form of blast-pot or "converter" which has heretofore been used for these pot-roasting processes, is open to many serious disadvantages, chiefly mechanical, of which the following list will suffice:

(1) The process is necessarily intermittent, requiring much handling of material, and constant attention in filling the pots, stopping blow-holes, etc.

(2) On account of the agitating effect of the blast as it issues from the top of the pot there is a considerable quantity of the charge particularly near the top which, though partially roasted, does not have a chance to sinter. In order to reduce the percentage of these unsintered fines the capacity of the converters is made very large, usually about ten tons to the charge. Under average conditions the quantity of fines will amount to from 10 to 30 per cent.

(3) On account of the mass-action in such a large converter, the central part of the sinter cake is apt to fuse together into a solid mass of slag, and thus lose the peculiar, cellular, coke-like structure which is such an important desideratum of the product. It also involves much extra labor in breaking up the mass after it has been discharged from the converter.

(4) It has been shown by H. O. Hofman (see paper on "Lime Roasting a Galena Concentrate," *Trans.* A. I. M. E., Vol. XXXVIII) that the sintering action in an ordinary converter, blown from below, starts at the place of ignition at the bottom and moves slowly to the top; and the time during which a given particle is exposed to the maximum heat of sintering (1000 to 1200 deg. C.), is not more than a minute or two, the temperature curves for a given layer in the converter showing a very sudden rise to, and a very sudden fall from the critical temperature-time of sintering. When this slowly rising plane of fire reaches the top surface of the charge in the pot the operation is completee. It must be very evident therefore, that in a converter of many tons capacity most of the space is

FIG. 2. SINTER CARRYING 50 PER CENT. LEAD MADE FROM GALENA CONCENTRATES, WITHOUT LIME

occupied by particles which are either waiting to be sintered, or having been sintered, are waiting to have the rest of the charge finished. Hence the greatest part of the capacity of the converter is used for storing and not for actually treating its contents, and we are therefore forced to the conclusion that, considered strictly as a metallurgical furnace, the capacity-efficiency of the Huntington & Heberlein converter is very low.

Ideal Conditions

If this reasoning is correct, it follows that ideal results as to character of product and economy of operation would be obtained: (a) If the treatment could be made continuous; (b) if the material could be presented and maintained in a quiescent condition; (c) if a thin layer, charge, or succession of charges could be employed.

After some very extensive experiments in this direction by R. L. Loyd and myself, we found that one very important matter was to follow such a course that, from start to finish, the particles throughout the entire mass were prevented from agitation, or disturbance, and particularly those particles in that part of the mass in the region where the gases made their exit. In other words, we discovered that complete quiescence was one of the incidents of superior sintering, which apparently requires that at the instant of maximum temperature all the particles of the mass in that locality must remain in practically the same relative position and in close contact, each with its neighbors. There are many ways of accomplishing this effect, and with a great variety of apparatus, employing up-draft, down-draft, or side-draft.

By effecting the treatment of ore while it, as a mass, is undergoing movement, new lines of economy, not attainable by any of the earlier and intermittent processes, are opened up.

The Dwight & Lloyd Machine

While it is not the purpose of this paper to attempt to describe all of the numerous matters incident to this process, and the forms of apparatus that have been devised for carrying it out, a few of the important features will be here referred to. For example, a simple and convenient form of the Dwight & Lloyd machine which has given very satisfactory results under actual working conditions extending now over a considerable period of time, is that shown in Fig. 1, which machine is at present in continuous daily operation, under regular smelter conditions, treating copper concentrates and flue dust.

Fig. 2 shows a pile of about 50 tons of the product of this machine made from high-grade galena concentrates. The sinter carried more than 50 per cent. lead and less than 3.5 per cent. sulphur. The capacity of the machine on this charge was 1.3 tons of dry charge per hour, or somewhat over 30 tons per day, with a 4-in. layer and a blast pressure of 4 oz. No preliminary roasting was necessary, nor was any form of lime used in the mixture. A total power consumption of 12 h.p., as shown by meter readings, was sufficient to operate the machine and suction fan. The gases during the treatment of this lead ore were passed through a bag-house and the lead loss was proved to be a negligible quantity.

Fig. 3 is a photograph of a cake of sinter made from a mixture of copper concentrates and flue dust. It illustrates very clearly the favorable structure of the product.

The general arrangement of the apparatus is shown in the photograph. It consists of a pair of circular rims of iron carrying a set of cast-iron, herringbone grates, the whole forming a drum-shaped structure, resting on rollers like a copper converter. The drum acts essentially as an endless conveyer, and is caused to move slowly about its axis by the friction of the drive-rollers. Inside the drum and occupying the top quadrant of the circle is a stationary suction box, connected with a suction fan. The moving rims make an air-tight joint with the edges of the stationary suction box. The material to be sintered is fed in a thin layer upon the grated face of the drum from an over-head ore-hopper, immediately after which the stream of ore passes under the igniter which may be a series of gas jets, an oil flame, a charcoal brazier, hot roasted ore or even hot sinter, whereby the top surface of the ore stream is kindled uniformly across the whole width of the conveyer. The roasting action so begun is maintained and augmented by the streams of air which are sucked down through the moving layer of ore as it passes across the suction box.

When a 4-in. layer of ore is used, which has been found to be a convenient thickness, about 20 minutes will be required for the sintering action to be completed, and the speed of the periphery is so regulated that the layer shall be completely sintered down to the grate by the time it reaches the far end of the suction box. The discharging is done automatically by the pointed grizzly frame which strips the end of the finished sinter-cake from

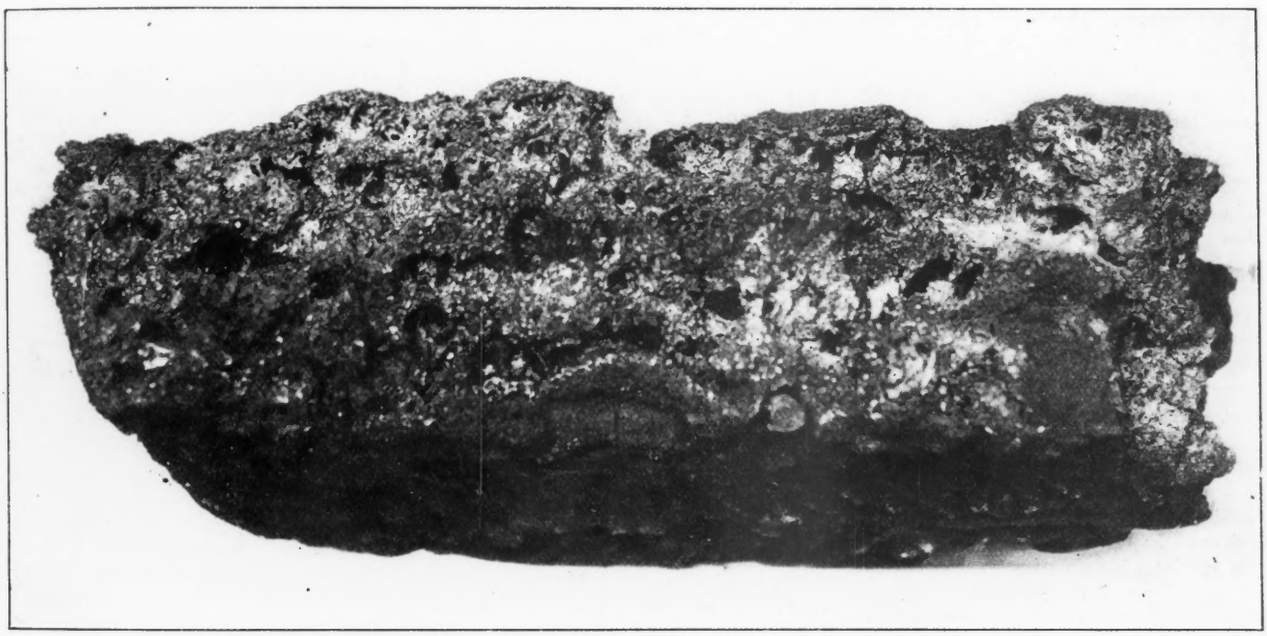


FIG. 3. SINTER MADE FROM COPPER CONCENTRATES AND FLUE DUST

the face of the wheel like bark from a tree.

When the machine is sintering properly the grates do not clog. The best speed for the periphery will depend upon the character of the material under treatment; thus with the leady charge above described, it was about 5 inches per minute.

Before being fed to the machine, the ingredients of the charge should be thoroughly mixed and moistened to the proper degree. This moisture not only prevents the fresh charge from sifting through the apertures of the grate bars, but greatly promotes the activity of the sintering process.

It is evident that this same sequence of operations may be acomplished in many different mechanical ways, and a number of other types of machine have already been designed, built and operated for carrying on this process. The drum type of machine, here shown, has the minimum of moving parts to wear and get out of order and, therefore, presents some strong claims for preference.

Details and Costs

Contrary to what would be expected, the machine does not get very hot even when continuously handling a large tonnage, and the cast-iron grate bars do not make trouble by burning out.

It will be observed that all the adjustments governing the operation of the machine are under absolute control. The character of the mixture, thickness of layer, speed of travel, ignition, and blast pressure, can be set to produce the maximum output and best character of product, and when once set, can be maintained with a minimum of personal attendance. In fact, one man can as easily look out for a battery of several machines as he can for a single machine.

The cost factors developed from actual experience show that the cost per ton is considerably less than the best pot-roasting practice up to date.

The observance of some simple rules is necessary for the most successful results, but these have now been pretty well worked out, and there is nothing about the procedure that an ordinarily intelligent smelter workman cannot understand.

The range of composition of material from which a suitable sinter can be made, while not unlimited, has been found to be surprisingly wide; in fact much wider as to silica, iron, sulphur, etc., than the limits of composition of the blast-furnace charge of which it is to form a part, and it has also been found that for purely mechanical causes the chemical limits are wider when treating thin layers than they are with the pot-shaped converters of large capacity. This is perhaps most clearly shown by the ability of the Dwight & Lloyd system to treat galena concentrates high in lead without the admixture of any form of lime, as the advocates of the older processes claim to be necessary.

Advantages and Scope

The following suggestions are presented as to the advantages and scope of this process:

(1) On account of the peculiar cellular structure of the product, the fine ores destined for the blast furnace can be put into a form which is most admirably adapted to facilitate the reduction and smelting of the metals by the blast furnace gases. In this way increased fuel efficiency will be attained and the furnace speed will be greatly increased. This means a lowering of cost factors all along the line as any metallurgist will readily appreciate.

(2) The sintering of the fines will greatly reduce the amount of flue dust made, and what dust is made can be rehandled under most satisfactory conditions. In fact, flue dust is often a welcome addition to the sintering mixture in treating fine sulphide concentrates by this process.

(3) In cases where pyritic smelting is possible from the chemical character of the ores, but is negatived by its fine mechanical condition, the advantages of pyritic smelting may be successfully secured by making a rough separation of the fines from the coarse ore, sintering the fines to form a spongy sinter which, in combination with the coarse ore, will open up the charge in the blast furnace in the manner which seem necessary for the best pyritic work.

(4) In many isolated mining districts where concentrates are produced and shipped to distant smelting works, this process would serve a useful purpose in putting the concentrates into a convenient form for handling and permit of shipping them without the usual mechanical losses. At the same time the shipping weight would be reduced with consequent savings in the freight and smelting charges, and the product would be in a form most acceptable for the smelter.

(5) The process readily lends itself to the successful solution of many special problems in ore concentration and smelting.

(6) On account of the concentrated character of the sulphur gases that can be produced, and the correspondingly small volume, the system may be a convenient adjunct to any scheme for utilizing or rendering innocuous the sulphur in the waste gases. This is becoming an important matter in many districts where the farmers are raising objections to the smoke nuisance.

The capacity of the machine is approximately 1 to 1¼ tons per day per square foot of effective hearth area, while the cost of installation is but a small fraction of that of a mechanical roasting plant of equivalent capacity.

This system of treatment is protected by numerous patents, both granted and pending.

Tennessee Copper Company

In 1907 the mines produced 383,631 tons of ore. At the end of the year the ore developed in the Polk County mine was 126,966 tons; in the Burra Burra, 1,806,960; in the London, 359,443; total 2,293,369. The probable ore in the Burra Burra mine was estimated at 1,000,000 tons, and in the London mine at 30,000 tons.

The smelting works in 1907 treated 389,603 tons of ore, 8401 tons of converter slag, 23,045 tons of blast-furnace products, 89,035 tons of quartz flux, 91,280 tons of first matte and custom matte, and 3571 tons of custom ore, a total of 604,935 tons. The consumption of coke was 37,269 tons.

The mine, railway, smelter and construction works employed an average of 1211 men during the year.

The smelting works produced 12,599,019 lb. of copper, or 32.34 lb. per ton of ore. The cost of mining and smelting is given in the following table:

	Per Ton Ore.	Per Lb. Copper.
Mines development	$0.1318	0.407c.
Mining, hoisting, etc.	0.9389	2.904
Crushing and sorting	0.0804	0.249
Railway	0.1329	0.411
Blast furnace	1.6219	5.016
Engineering and laboratory	0.0628	0.194
General	0.1703	0.526
Converting	0.2402	0.743
	$3.3792	10.450c.
Adjustment of ore account	0.0045	0.014
Cost of fine copper in pig	$3.3747	10.436c.

The increased cost per ton of ore over the figures for 1906 is accounted for almost entirely by increase in rate of wages and increase of cost of supplies.

According to the report of the treasurer, 2,230,136 lb. of the copper produced were electrolytically refined during the first half of the year; the remainder was marketed in the form of pig copper. The cost of electrolytic copper, after allowing for gold and silver, was 12.22c. per lb. The cost of producing and marketing per pound of fine copper in pig was as follows: Cost at works, 10.44c.; freight, insurance and other selling expenses 0.68c.; taxes, legal and administration expenses 0.67c. total 11.79c.

The profits for the year after deducting $70,000 for depreciation of the plant in Tennessee, were $800,635. The sulphuric acid plant was completed in December, 1907, and is now producing acid. No revenue was derived from this source during 1907. The sum of $728,$67 was expended for new construction and equipment. Of this amount $504,525 was expended on the sulphuric-acid plant, and about $114,000 in improving the smelting plant.

The death rate from accidents in the Transvaal mines for the year ending June 30, 1907, was 8.62 per 1000, against 9.15 per 1000 during 1906.

The Southern Anthracite Coalfield

The Important Future Supply of Hard Coal Will Be Produced by Deep Mining in the Lower Basin. Water Hoists to Replace Pumping

BY JOHN H. HAERTTER*

The reopening of the Blackwood colliery of the Lehigh Valley Coal Company, the new Mary D. operation at Tuscarora, the completion of the Pine Knot and John Veith plants of the Philadelphia & Reading Coal and Iron Company, combined with other extensive and important development work, marks the beginning of renewed activity in the southern or Pottsville coalfield, and will assist in placing the Schuylkill region in the position in held in the early days of the anthracite industry.

The Pottsville field occupies the southern part of the Schuylkill region, and has the Panther creek basin as its eastern, and the village of Dauphin, near Harrisburg, as its western boundary; this forms a coal basin nearly 60 miles long, paralleling the Mahanoy-Shamokin district of the western middle field, and covering an area of 180 square miles. The main portion of the field, about 2 miles wide at Tamaqua, gradually grows wider to the west and, at Pottsville, which is located almost centrally east and west, is about 8 miles wide. It retains this width as far as Tremont, where a division into two long narrow prongs takes place; this division is commonly known as the "fish tail," the southern branch extending westward a distance of 23 miles, and tapering out near Dauphin village; the northern prong extends westward a distance of 16 miles and has an average width of 2 miles.

Topography

The southern rim of the field, which is also the southern boundary of the anthracite territory, is defined by the Pottsville conglomerate (see Fig. 1). The outcrop of this stratum is visible in the gaps in Sharp mountain at Tamaqua, Pottsville, Westwood, and Lorberry. Through the first three mentioned gaps flow the Little Schuylkill, Schuylkill and west branch of the Schuylkill rivers, respectively, and through the Lorberry gap the Swatara creek flows to the Susquehanna river. It is also through these gaps that the various railroads enter from a southerly direction; the Philadelphia & Reading has access through all four cuts, while the Pennsylvania enters at Pottsville and the Lehigh Valley at Westwood.

The topography of this region is unlike the northern field, but similar to the eastern and western middle basins. The interior is a succession of hills and ridges between which flow the small tributaries of the Schuylkill. The geological construction of the strata is wavy and folded (see Fig. 1), while the force of the thrust, which extended over the whole anthracite territory long after the coal beds had been deposited, is most pronounced in this basin, where overturned anticlinals prevail, and where the seams, originally horizontal, were changed to inclinations varying from a few degrees to perpendicular.

The beds in Sharp mountain dip almost vertically, as shown by the outcrop of the conglomerate at Pottsville at Fig. 1, and extend below the surface on that dip for a considerable distance before easing off to form the basin which extends along the mountain, and comprises the deepest part of the field. A clear conception of the formation and depths can be had by reference to Fig. 1, which is a section of the measures in the vicinity of Pottsville and on which are enumerated the principal workable beds.

Early History

From the fact that mines were opened soon after the discovery of coal near Pottsville, and mining was actually carried on until the region was the scene of great activity, a brief review of its early history and gradual development is interesting, and in fact necessary, to complete an account of the present and future standing of this southern anthracite field.

The first known discovery of anthracite coal was by Parshal Terry and a company of Connecticut pioneers at Mill creek, near Wilkes-Barre, Penn., in 1762. The presence of coal in the Schuylkill region was known as early as 1769. A map of Pennsylvania published in 1770, and constructed from surveys made by William Scull (erroneously published heretofore

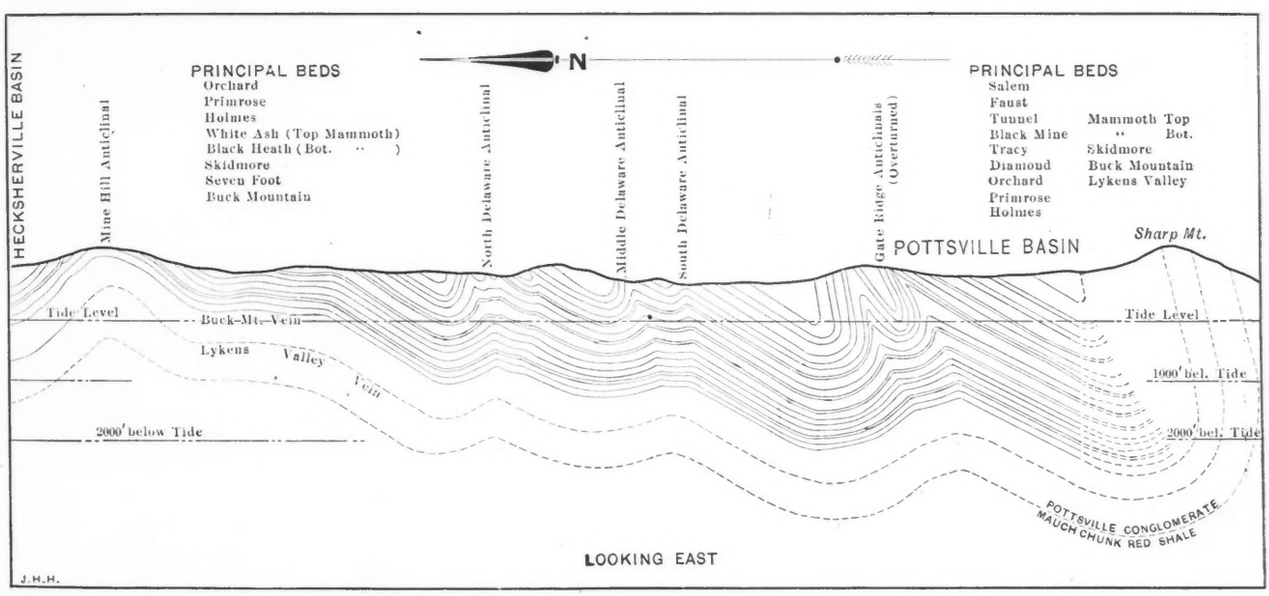


FIG. 1. TYPICAL SECTION ACROSS MEASURES NEAR POTTSVILLE IN THE SOUTHERN ANTHRACITE FIELD

*Mining engineer with Lehigh Valley Coal Company, Wilkes-Barre, Penn.

FIG. 2. FRONT VIEW OF STEEL HEAD-FRAME OVER "POTTSVILLE DEEP SHAFT"

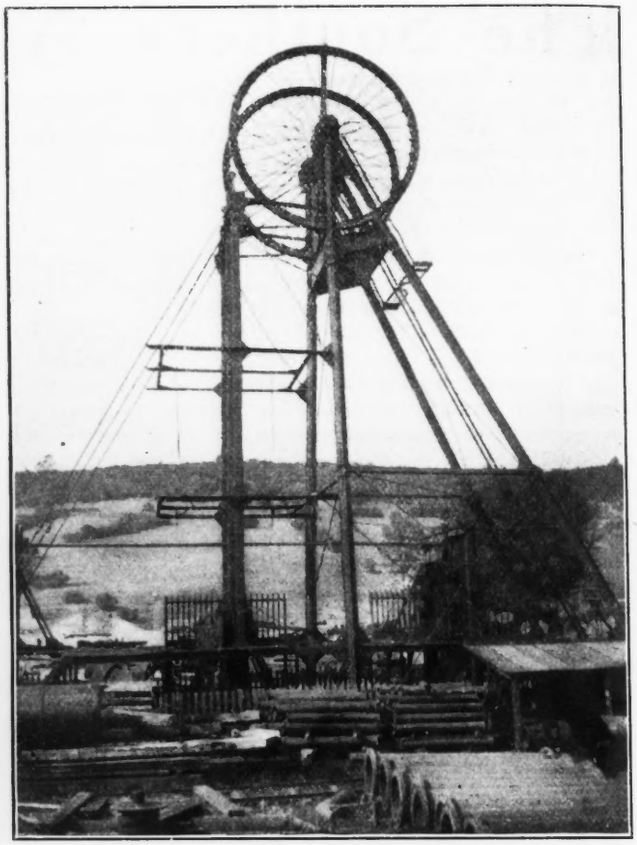


FIG. 3. SIDE VIEW OF HEAD-FRAME OVER FIRST DEEP SHAFT IN ANTHRACITE FIELD

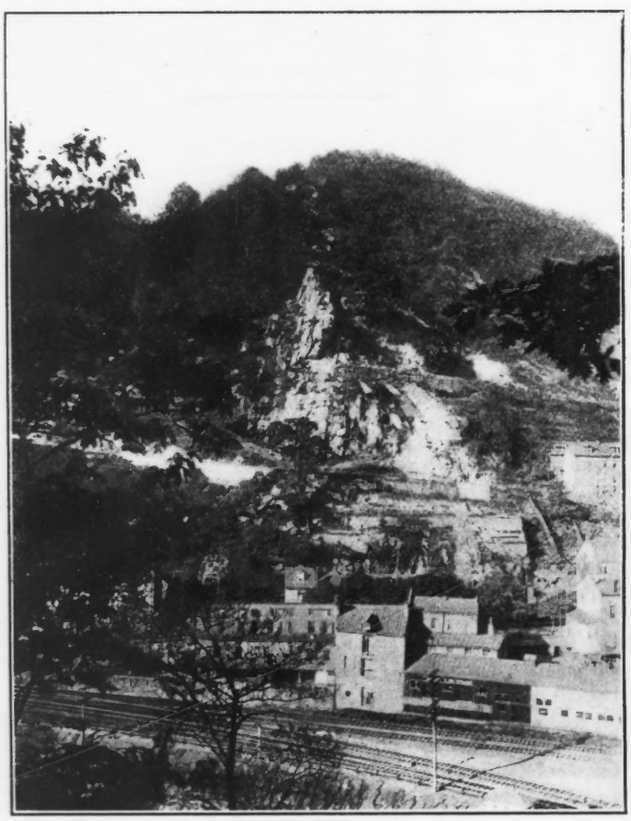


FIG. 4. WEST SIDE OF GAP IN SHARP MT. AT POTTSVILLE, SHOWING OUTCROP OF POTTSVILLE CONGLOMERATE

FIG. 5. WADESVILLE WATER SHAFT OF THE PHILADELPHIA & READING COAL AND IRON COMPANY. CAPACITY, 90,000 GAL. PER HOUR

as Searle) in 1769, clearly defines the location and courses of the Schuylkill river and its tributaries, as well as the location of the Sharp mountain. At the site of the present borough of Pottsville is plainly printed the word "coal," also at a point north of Mahanoy creek. The legislature of Pennsylvania, 14 years after the date of the Scull map, passed an act, approved March 15, 1874, making the Schuylkill river navigable. The ninth section reads in part, "from thence . . . to the coal mines on Schuylkill, at Basler's saw mill," etc., so that it is only reasonable to assume that seams were being opened and coal was actually mined about this time. Old maps showing the position of Basler's mill locate it in the southeastern part of Pottsville.

Early Shipments

The first known shipment of anthracite coal was made by the proprietary governors of Pennsylvania from the Wyoming region via the Susquehanna river and thence by wagon to Carlisle, Penn., in 1776. In 1818 the Lehigh Navigation Company was organized, and in 1820

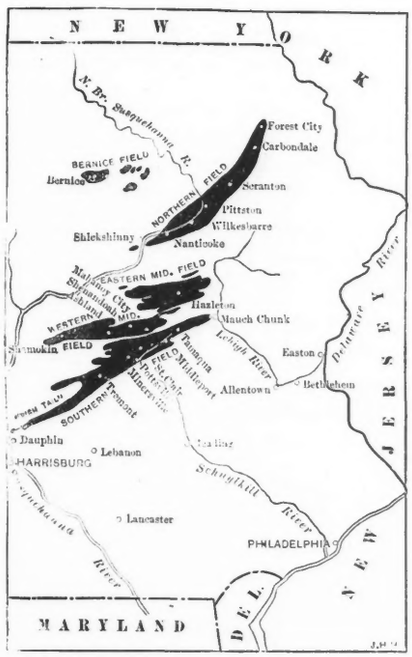


FIG. 6. EASTERN PART OF PENNSYLVANIA, SHOWING ANTHRACITE COALFIELDS

shipped to Philadelphia 365 tons via the Lehigh river; this latter date has always been used as the date of the beginning of the permanent anthracite trade. Early records say that coal was plentiful in the vicinity of Pottsville; but no great activity was shown in mining it until about 1813, when a number of mines were opened and coal sold locally at $3.50 per ton; the fuel at that time consisted of the raw product as it came from the mine, breakers and preparation being entirely unknown.

The Schuylkill Navigation Company was organized in 1815, and the Schuylkill canal was completed from Philadelphia to Mount Carbon, about one mile below Pottsville, in 1825. Extensive mining soon proved the canal too slow for handling the output, and construction was commenced on the Mount Carbon, or what is now known as the Philadelphia & Reading railroad, in 1835; the first shipments of coal by this road were carried to market in 1841. The number of mines increased rapidly, and the Schuylkill region ranked first in point of annual shipments until 1867, when it was replaced by the Wyoming region where the basins were not so deep, and mining could be carried on cheaper and with more rapidity.

Anthracite mining has now reached the stage where the deeper remaining beds make up the future and last supply of hard coal that is available. Deep shafts will consequently be the only profitable way of reaching these beds. An early attempt at deep-shaft mining was made somewhere about 1880 when the Philadelphia & Reading Coal and Iron Company put down at one of its mines, a mile northeast of Pottsville, what has long been known as the "Pottsville Deep Shaft." It was sunk to a depth of nearly 1600 ft., a steel head-frame was placed over it, and a powerful pair of 45x60-in. first-motion engines with conical drums, completed what was considered at that time, and for many years, one of the greatest coal plants ever constructed.

This plant attracted the general attention of mining men and was the subject of a paper by the late Eckley B. Coxe (*Trans.*, A. I. M. E., Vol. 1). Conditions at that time were unfavorable for profits in deep mining and the installation was soon abandoned. The territory is now being mined through the Wadesville colliery farther west; the original headframe and engines are still intact, but are now only noticed for the interest they create as being a part of the first deep-shaft installation in the anthracite coalfields.

The only coal in the southern field, that may be considered virgin territory, is that portion of the district which is located in the deep synclinal trough extending along the base of Sharp mountain from Tamaqua on the east to Tremont on the west. The locations of present operating collieries in the main portion of the field are shown in Fig. 7.

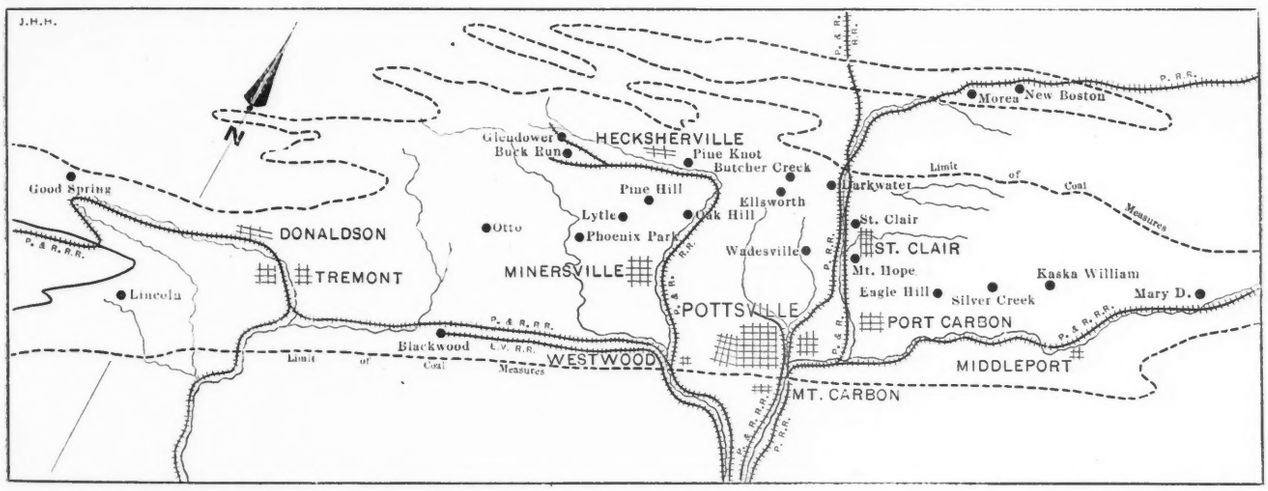


FIG. 7. MAIN PORTION OF SOUTHERN COALFIELD SHOWING PRESENT OPERATIONS AND RAILROAD OUTLETS

With the recent purchase by the Delaware & Hudson Company of the remaining acreage of private holdings, practically the entire area of coal land in the Southern field passes under corporation control. Excluding the small producers, quite a few in number, there are now not more than eight or ten individual operations. The following figures, collected from the report of the Department of Mines of Pennsylvania for 1905 will show the distribution of tonnage. The year 1905 is taken since the 1906 output was curtailed by the temporary suspension during April and part of May.

The total anthracite production in 1905 was 70,220,554 long tons, that of the

southern field was 7,058,640 tons or about 10 per cent. of the former.

The Pottsville basin will furnish splendid opportunity to engineering skill for the best methods to reach and develop the underlying seams, the lowest of which is estimated to be 3000 ft. below the surface. It is probable that in the near future, a series of tunnels will be driven from the surface and at suitable vertical intervals into Sharp mountain, in this way cutting all the seams to the lowest workable ones. These tunnels will not only reduce the cost of haulage and drainage, but will at the same time prove the different seams and greatly assist in the correct geological correlation of the strata.

SOUTHERN ANTHRACITE COAL FIELD.

Tonnage Produced in 1905.

	Production in Tons.			Per Cent. of Total Production.
	Mined.	Washery.	Total.	
LARGE COMPANIES.				
Phila. & Reading Coal & Iron Co.	2,672,324	195,254	2,867,578	
Lehigh Coal & Navigation Co	1,069,128	.....	1,069,128	
Coal Companies of Penna. R. R.	1,030,968	.....	1,030,968	
Lehigh Valley Coal Co.	*9,715	.....	*9,715	
	4,782,135	195,254	4,977,389	70.5
INDIVIDUAL COMPANIES. (Producing over 100,000 tons.)				
St. Clair Coal Co.	452,506	51,894	504,400	
Buck Run Coal Co.	266,593	.....	266,593	
Oak Hill Coal Co.	174,601	.....	174,601	
Pine Hill Coal Co.	120,164	24,884	145,048	
Truman M. Dodson Coal Co.	118,052	.....	118,052	
Dodson Coal Co.	114,631	.....	114,631	
	1,246,547	76,778	1,323,325	18.8
Other small operations	561,506	196,420	757,926	10.7
Total production	6,590,188	468,452	7,058,640	

*Tonnage derived from opening up Blackwood Colliery which commenced operation in 1906.

Developing the Deeper Beds

The various overlying seams in the Pottsville basin have been successfully developed by means of rock slopes, but the most economical and eventually the best method of reaching the lower beds will be by deep shafts of sufficient size and equipment. Suitable locations for permanent shafts cannot be definitely fixed until the conditions and structural formations become better known. The best present knowledge of the geological structure is entirely theoretical, and only further development will assist the engineer in deciding on proper methods for opening up and developing the deeper beds. So far but little prospecting has been done in the way of diamond-drilling or trial-shafting, and rock formations and coal outcrops are exposed in but a few places.

Drainage will undoubtedly be an important subject to consider in the future development of this field, and because of the high inclination of the strata and the numerous beds, 20 or more, surface water will readily find channels to the inside workings. As mining goes deeper, the amount of water liberated by cutting underground water courses will increase. Doubtless the equipment of this field will soon include many hoisting plants installed exclusively for removing mine water in tanks instead of by pumping. A striking example of the efficiency and economy of this system is furnished in the case of the Lytle operation near Minersville, Penn. This colliery is extremely wet, and the shaft, which is 1650 ft. deep, was filled with water to a depth of 860 ft. during the strike of 1902. After the strike was ended, tanks were put in the four coal compartments, in addition to the regular water hoists, and the water amounting to 274,083,500 gal., was hoisted out in 37 days and a few odd hours. On former occasions, this same work required seven months by pumping at an expenditure of nearly $6000, excluding the value of the coal burned. There are many water-hoisting plants in successful operation throughout the anthracite field, and the results already obtained, besides the advantages over pumps and steam lines underground will be conducive to the final adoption of this satisfactory system, especially in deep mines.

The Water Supply

The task of obtaining a pure water supply for steam purposes will in time be a difficult one. Fresh-water streams, in this field, aside from those owned by water companies operating in the vicinity, are scarce. Several coal companies are now compelled to purify mine water for boiler use. Water for coal washing purposes will be readily obtainable, as the quantity of mine water which will have to be pumped or raised to the surface, will furnish an abundant supply.

The duration, or life of the southern field, is entirely dependent on unknown conditions at depth. It has been estimated that the anthracite area, before mining began, contained about 19,500,000,000 tons, of which about 9,200,000,000 or almost one-half of the entire tonnage was contained in the southern field. All present estimates, however, are most uncertain, for the actual life of the field may be prolonged beyond its estimated life as has been the case in other fields, where monstrous stripping operations continue to furnish a coal supply far beyond the output estimated. The southern basin has long been considered as containing the great future remaining supply of anthracite, and while other fields will furnish a considerable output during their remaining years, the lower districts will soon be the territory to which mining men will turn for the last supply of hard coal.

The development of this region will certainly stand out in great contrast to that of the other fields. Here we can expect to see centralized plants with breakers of enormous capacity and containing modern machinery for preparation. Modern methods already favor the replacing of small breakers and plants by one large central operation, which is designed to produce the same, or a greater tonnage than the numerous small plants have handled.

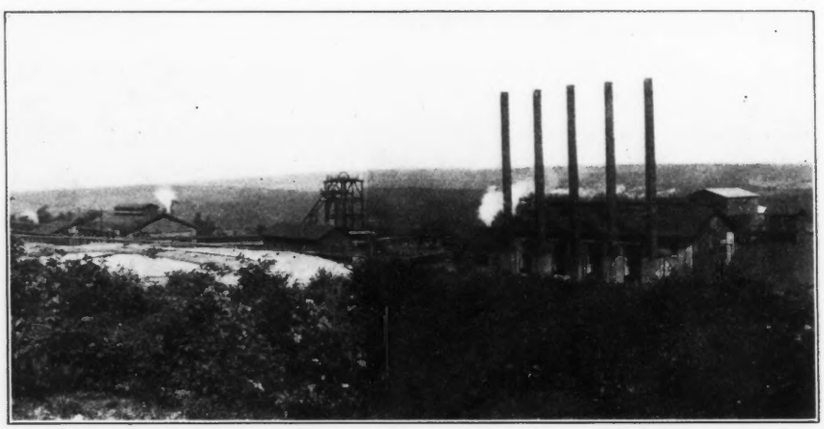


FIG. 8. BLACKWOOD COLLIERY OF LEHIGH VALLEY COAL COMPANY. LOCATED 7 MILES WEST OF POTTSVILLE

On the Rand a Kafir goes to surface as soon as he drills 36 in. of hole.

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March 7	12,000
March 14	9,500
March 21	9,500
March 28	9,500

None sent free regularly, no back numbers. Figures are live, net circulation.

Contents

The Commercial Aspect of Rand "Profits"

Under this title George A. Denny, who is eminently qualified to discuss the subject, publishes in pamphlet form the series of articles, contributed originally to *The Mining Journal* (London) last year, which has recently been republished, in rather full abstract, in this JOURNAL. His analysis of mining conditions on the Rand and the mines of the latter from the investor's standpoint is of immense importance, not only in its bearing upon the particular subject but also in its general application to a commonly neglected phase of mining finance.

Summarized broadly, this principle is that a mine to be profitable must return the full investment in it plus the interest which the money would have earned if put into bonds or other first-class securities that are available. The inducement to put money into mines is the larger return which they may make, the magnitude of the return, in other words the ratio of annual dividend to market value of the shares, being theoretically proportional to the risk. It is elementary that the annual profit of a mine does not represent interest on principal. If a mine involving an investment of $1,000,000 pays $100,000 per annum for 10 years and then is exhausted, the investor has simply recovered his money and has lost interest upon it to a large amount.

Of course this principle is so well known that it requires no restatement, but practically it is obscured by a variety of conditions, among which are (1) the general practice of mining companies to distribute all of their net earnings, leaving the stockholders to figure amortization for themselves, (2) the notion of most stockholders that they will draw dividends for a few years and then sell their stock at least for cost, and (3) the inability in the majority of cases to determine in advance the probable life of the mine. Who, for example, could reasonably predict the probable life of such mines as those at Cobalt, Ontario, or Batopilas, Mexico?

However, there are mines, like the Franklin mine of New Jersey, whereof the orebody is delimited, and other mines, like the copper lodes of Lake Superior and collieries in general, whereof the life can be fairly approximated and amortization can be based upon the determination of reasonable probabilities. The gold mines of the Rand fall under this category. Mr. Denny argues that in their case amortization has not been sufficiently allowed for, and that many mines, commonly considered profitable, in reality are not so; in other words, investors in their shares will not get their money back, or would have been richer in the end if they had invested in consols, which as everyone knows yield only a low rate of interest. We think that no one will question the truth of this assertion, nor the further one that the managers of mining companies are apt to make a showing of "profit" larger than the profit really is, but it is going too far to declare the Rand mines as a whole to be unprofitable. The companies may be unprofitable to the stockholders, and yet the mines may be profitable, as the outcrop mines doubtless have been. The difference between these conditions is that the profits have been to a large extent anticipated by the vendors and promoters. This is a common event in mining finance. There are many good mines in America as well as in South Africa, which are the basis of unprofitable companies because the profit of the mines as such has been entirely anticipated in the organization of the company. It was not a part of Mr. Denny's thesis to go deeply into this phase of the question, but it is a matter of mining finance that is not given sufficient attention by the purchasers of mining shares, partly because usually they have no one to advise them, and partly because it is so often that they do not intend to be permanent holders, although it is a common occurrence that they become so perforce. The loss which then ensues is the result of the disregard of the principle of amortization and the element of time in the earning power of money and the anticipation of profits by earlier owners of the property.

The importance of the element of time is emphasized by Mr. Denny in certain of his analyses of the capital accounts of Rand companies, which have had to raise large sums of money and prosecute development work for many years before net earnings could materialize. The loss of interest on capital during such periods is, of course, a charge against future profits. The stupendous losses that may result from deferred production are such

that the policy of "husbanding the company's resources," which is so often announced as an excuse for inactivity, if fully realized would be in many cases, in the words of Mr. Denny, "altered to one which would cause an immediate redistribution of the available assets." The loss of income through deferred profits is also a matter that bears upon the curtailment of production by copper and lead mines for market purposes, as is recognized no doubt by such enlightened managements as those of the Calumet & Hecla Mining Company and St. Joseph Lead Company, which do not curtail production and continue to sell their output so long as they can do so at a profit.

On the same line of reasoning, Mr. Denny points out that the deep-level claims of the average yield of the Rand can not be worked at a profit under the present conditions of equipment and development cost, considering amortization and interest charges, even if the properties could be acquired for nothing. In other words they have no present value, and the only safe course is to postpone capitalization until they are within a safe margin of profitable activity. "Until that time," says Mr. Denny, "they must be regarded as having no relation to commerce, in precisely the same manner as though they were undiscovered treasures of nature. If this view were not sound, then the potential value of all natural deposits must be discounted from the date in human history when they attained commercial value. They would thus be saddled with colossal accumulations of interest. * * * This is, of course, absurd. The deposits can only have a commercial relation when they become the object of commercial enterprise." This is entirely sound. We have heard much respecting the waste of our natural resources, and are hearing a great deal about it now. There have been and are some sad wastes beyond doubt, but many discardings that are called wastes are really not so, considering the questions of capital and interest. Does anyone suppose that the United States would be so wealthy a nation if the development of its sulphide mines had been deferred until sulphuric acid could be made from the sulphur that is being thrown away?

We shall not discuss at much length the technical parts of Mr. Denny's articles, although we hope that our readers will do so, because they present many interesting and important points. Of course the situation on the Rand is such that working costs must be reduced, and it is evident that they can be inasmuch as the efforts of some of the engineers are already bearing fruit. It may be, as Mr. Denny remarks, that "The Rand has run amuck with capital expenditure," but it does not follow that the outlay of further capital if wisely made may not lead to economies in working costs, including the amortization and interest charges that Mr. Denny emphasizes. The installation of mechanical conveyers at the New Kleinfontein, described in a recent paper by E. J. Way, shows how greatly such a mechanicalization may pay—really pay. We question the value of Mr. Denny's suggestion that great economy would be realized from the establishment of central reduction works, for which an amortization extending over a 50-year period may be reckoned, against 10 to 15 years for the mines. The question of works amortization was recently discussed in the JOURNAL, the point being whether a 20-year period was not too long in the most favorable case.

In the conclusion of his paper, Mr. Denny refers rather pessimistically to the record of the Rand, asserting that its gold production has been obtained at a loss. This will not, we think, be readily admitted. It is undoubtedly true that the large dividends that have been paid are far from being all profit; it is probably true, moreover, that the stockholders in some dividend-paying mines will not recoup their investments; but the Rand has made great fortunes for a large group of magnates, who have anticipated profits, and the full data are not available to warrant the pronouncement that the mines themselves have been wholly unprofitable on the basis of actual expenditures.

The New Mining and Metallurgical Society

At a meeting of engineers interested in the formation of a new mining and metallurgical society, at New York last week, it was decided to proceed with plans for organization. It is the intention to make a strictly professional society, with distinct qualifications for membership, more or less of the nature of those imposed by the Institution of Mining and Metallurgy. There appears to be a decided demand for the creation of such society.

Recognizing that the new society will now be formed (a meeting of the charter members is to be held on or before April 20, if possible) it will be a source of regret if arrangements be not made for an affiliation between it and the American Institute of Mining Engineers. We believe that it is possible to effect such an affiliation so that the Institute will not lose in membership or ability to carry on its publication of technical papers and plans to create a great technical library, while on the other hand the new association will be able to carry out its special plans. An earnest effort to consummate such an understanding will be made, we believe with good promise of success. A division of membership among two technical societies will not be to the best interest of the profession.

THE UNITED STATES Steel Corporation gives its stockholders and the public a full and fair report of its operations for the past year. It was the best in the history of the corporation, notwithstanding the break near the close of the year, which came too late to reduce the totals very much. The figures are so large that it is rather difficult to comprehend them. The gross earnings for the year were $757,014,768, probably the largest sum ever earned by a single organization. Of this enormous sum 73.6 per cent. was absorbed by operating expenses and repairs; 5.4 by general expenses; 7.4 by interest and sinking funds. The dividends paid were 5.4 per cent. of the gross earnings, and appropriation for new plants 7 per cent., the corporation continuing its wise policy of adding to its works from current earnings.

IT IS CHEERFUL to hear the mine managers at Butte talking about producing copper at 10 to 11c. per lb. According to the Anaconda report for 1905, its cost in that year fell between those figures, and there is no good reason why it should not be repeated. The high cost in 1906 and 1907 was due largely to a falling off in the efficiency of the labor, which of course was well known not only to the Butte managers, but also to every mining engineer who inspected the mines. This drawback appears now to have been corrected.

Metallics

The force from the explosion of dynamite is equal in all directions, the opinion of many practical miners to the contrary notwithstanding.

Silver amalgam apparently is as good as gold amalgam for setting new copper amalgamating plates. The silver amalgam can be made by heating a partly filled bottle of mercury almost to its vaporizing point (180-200 deg. C.) and then dropping thin sheets of silver into the mercury. Upon shaking the bottle, these strips soon dissolve in the mercury.

The clean-up room at the Great Boulder Perseverance mine is equipped with a hood, suction fan, and mechanical dust-collector system. All screening and mixing of the sludge from the zinc boxes is done under the hood, which is equipped with canvas curtains that reach almost to the floor. Thus most of the dust is saved. The cost of the equipment installed was $300. The dust saved soon paid for the installation.

A bad piece of ground is often in such a position that it is awkward and dangerous to pry it down with a bar or pick. In such cases it is best to blast the ground down with dynamite. The dynamite can be worked into the crack behind the slab, or, if that is impossible, often the mere pasting of the dynamite against the face of the slab by means of clay is sufficient as the jar of the explosion will generally break down the slab.

Litharge in the crucible assay acts in three ways: (1) when melted with sulphides and compounds of the base metals, it oxidizes both the metals and the acid elements with the evolution of volatile oxides, such as SO_2 and As_2O_3; (2) the molten litharge forms easily fusible mixtures with the oxides of the metals; (3) a portion of the litharge is reduced during the oxidation to metallic lead, which collects the gold and silver in a button.

Any work done for the purpose of discovering ore has been declared by the United States courts (United States *v* Iron-Silver Company, Federal Reporter, Vol. 24, p. 568) to be improvements within the spirit of the law. Therefore holes drilled with a churn drill in the search for mineral would count for assessment work. Even building flumes, drains or the turning of a stream, the work done aiding in the development of ore, have been allowed to count. When a mine is idle, the time and labor of a watchman can be counted as assessment work.

"Resuing" has made it possible at the Jumpers mine, Transvaal, South Africa, to work narrow reefs that formerly could not be made to pay. The miners work on royalty; as usual the greater the value of the ore the greater the company's royalty. The tributers pay for everything they use, such as supplies, native wages and compound expenses. The tributer has to deliver the ore to the chute in the stope; there the company takes it. The tributer is charged 10s., or $2.40, per ton for milling, subsequent handling and general expenses on all ore that he delivers to the company. This charge causes him to sort the ore clean in the stope. This method has been found very successful at the Jumpers mine and it is now being tried at the Windsor mine.

"Bull-dozing boulders" is a term used in Western mines to designate the breaking of boulders by the exploding of dynamite on the surface of the boulder. The dynamite is worked into a crevice or into a shallow hole, gouged out with a pick, and is plastered over with fine ore, or with clay or talc if any is handy. The blast is also often called a "paster." Large boulders can be broken in this way but much dynamite is consumed in the operation. It is this use of dynamite which has helped to fasten, in the mind of the miner, the mistaken notion that the force of dynamite is mainly downward. Bull-dozing of boulders should not be done often in timbered stopes as it is hard on the timbers. In square-set stopes it is especially to be condemned as the concussion rips up the floors.

Not only on account of moisture, but also on account of liability of danger from objects falling in the shaft, it is best, even in dry shafts, to encase the electric-power cable in a protecting iron pipe. The protecting pipe can easily be supported from the timbers but, when the shaft is deep, the weight of the cable is too great to permit its being suspended merely from the top. Under such conditions the line can be supported by clamping the bottom of the cable to the bottom of the pipe and then lowering sufficient slack in the pipe so that the cable will twist into coils and come in contact with the iron pipe. Friction between the cable and the pipe is then great enough to support most of the weight of the cable and the rest can be borne by fastening the top end of the cable.

The following methods of thawing dynamite have resulted in accidents in England from 1872 to 1905: Heating dynamite over fire caused 38 accidents; reheating water, in which dynamite had been previously placed to thaw, 11; placing the explosive in water and then heating over a fire, 10; placing the dynamite in ovens, 8; thawing cartridges in the hands over a lighted lamp or candle, 7; placing dynamite in hot ashes, 7; warming on a shovel over a fire, 5; placing dynamite on top of heated stone, 5; on a hot iron, 4; on a steam pipe, 2; rubbing sticks of dynamite together to warm them by friction, 1. A simple and safe way to thaw dynamite is to put the dynamite in a bucket or tin can and place this vessel in another bucket filled with hot water. Wrap the two up in old cloth or place in an air-tight box to retain the heat. This is an effective method and one that does not injure the dynamite.

In hand drilling there is considerable waste of steel from the battering of the head of the drill. This wear can be avoided by hardening the head. The head must not be made too hard or there will be a tendency to chip. At the Windsor mine, Transvaal, South Africa, the heads of 25 drills, made from ¾-in. octagonal steel of good quality, were hardened by quenching the head end at the dullest observable red in cold water; 25 other drills made from the same steel were not hardened at the head. After a month's use the drills with the hardened heads showed a maximum wear at the bit end of ¾ in. and a minimum wear of ¼ in., average ½ in. The wear at the head end was unappreciable. The drills with unhardened head showed the same wear at the chisel end, but at the head end the maximum wear was 2½ in. and the minimum, 1 in., average 1⅝ in. The ground is easy to drill so that generally the bit of the drills only had to be dressed. This, of course, made the proportion of the wear at the head end unduly large.

Shafts have been sunk by drilling with core-drills a series of vertical holes; the holes were filled with sand, the sand being cleaned out and the top part of the holes loaded as different rounds were blasted. This method has not proved successful because, owing to the arrangement of the holes, the ground has to be crushed out rather than blasted out. This injures the walls of the shaft and the amount of explosive used is high. Apparently owing to the less effect of dynamite the use of a series of such holes drilled by churn drills would be still less successful. Generally sinking with hand drilling is as cheap as any other method of sinking except in very wet shafts but commonly it is slower than when air drills are used. Still in South Africa the record in shaft sinking was made by using hand drilling. Churn drills have been used in the Wisconsin zinc district in sinking wet shafts, but for drilling two holes placed near the shaft, in which column-pipe Cornish pumps were placed, and not for drilling holes to be blasted. By pumping the water through these two holes the bottom of the shaft was kept fairly dry. The drill holes were within a few feet of the shaft, but frequent holes had to be drilled from the shaft to these holes to aid in the draining of the shaft bottom. The main advantage of hand drilling for shaft sinking is the more solid condition in which the walls of the shaft are left when hand drilling is used instead of machine drilling. Air-hammer drills have been used for sinking shafts, and the cost and speed of sinking were satisfactory.

Views, Suggestions and Experiences of Readers

Comments on Questions Arising in Technical Practice or Suggested by Articles in the Journal, and Inquiries for Information

CORRESPONDENCE AND DISCUSSION

Matte Smelting at Ingot, California

In the issue of Feb. 29, 1908, of the JOURNAL, appeared an article by W. B. Bretherton, entitled "Matte Smelting at Ingot, California," which proved exceedingly interesting to me. In this article, reference is made to the work of S. E. Bretherton's predecessor. Judging from various statements in Mr. Bretherton's article, he cannot be reliably informed as to former metallurgical operations, and I, as his predecessor, therefore, take occasion to supplement his article by some data which I trust will prove interesting to the profession.

In the fall of 1903, I was engaged as engineer to design and erect a pyrite smelter to treat the ores of the Afterthought mines. A large portion of the smelter equipment, such as the furnace, the Green blower, sampling mill machinery, etc., was already on the property, having been brought from mines at Copley belonging to the company. This furnace had been built to treat oxidized ores, and was therefore, not originally designed and proportioned for treating pyrite ores, in which practical experience has proved that furnaces with almost straight jackets, that is, with hardly any bosh above the furnace focus, give the best results. The smelter was completed early in 1905, and described in this JOURNAL, July 8, 1905.

I had nothing to do with the mine operations, and the shaping of future metallurgical operations at the smelter was based on samples furnished by the mine management. A portion of these samples contained a high percentage of zinc in the form of blende; another portion was fairly free from it, and it was represented to me that ores could be stoped containing practically no zinc, separate from ores containing zinc blende. This would have permitted of a blending of the different grades of ores, giving a certain flexibility to the blast-furnace operations in the preparation of the charges. The average copper content of the mine samples was about 5 per cent., and I figured to be able to carry 5 per cent. copper in the blast-furnace burden.

ADVERSE CONDITIONS

The first stope at the mines was opened in the latter part of February, 1905, and the smelter was blown in in March, 1905. The first ore shipments when run through the sampling mill averaged 2.83 per cent. copper and 18 per cent. zinc in the form of zinc sulphide. With the small iron content in the ore (14 to 20 per cent.), and zinc sulphide, heavy spar, and alumina forming 50 per cent. of the ore, and no clean iron sulphide being available, the zinc sulphide could not be completely slagged (held in solution in the slag) and it accumulated in the furnace shaft and obstructed the shaft until the furnace froze. These accretions analyzed as high as 45 to 50 per cent. zinc.

Mr. Bretherton, I am informed, had the same difficulty, although to a less extent, as further mine development opened some fairly clean bodies of iron sulphides. With coke costing $21 to $23 a ton, with only 2½ per cent. copper, $2.03 gold and 6 oz. silver on the blast furnace burden, the high cost of labor and limited capacity of the furnace with the refractory character of the ore made the smelting operations unprofitable under conditions then existing. Costs of producing copper in cents per pound, were as follows:

Mining	6.000c.
Smelting	7.895
Freight, bessemerizing and refining	6.917
Redemption and interest	1.053
Total	21.865c.
Credit for gold and silver	7.857
Net cost	14.008c.

These costs are based on an average furnace capacity of 100 tons burden with 2½ per cent. copper, 6 oz. silver and $2.03 gold. These amounts of silver and gold represent values actually recovered in the matte, and the value of gold and silver contained in the quartz ores, which were not regularly sampled, analyzed and assayed, and which were used as flux, are included in the averages. The costs are based on a copper loss of 5 per cent., a silver loss of 5 per cent. and a further 5 per cent. deduction of the silver in the matte by the buyers of the matte. Gold is figured at $20 an oz. The average prices of silver and copper in May, 1905, in New York, were respectively 57.832c. per oz., and 14.627c. per lb., which prices formed the basis of this cost calculation, and show conclusively that under the existing conditions at that time, there could be no profit in smelting. For the correctness of the cost of mining I cannot vouch, but I have reasons to believe that it represents the actual cost of mining the ore without the added expense due to current mine development, redemption of and interest on the capital invested for the purchase of the mine, and development done before commencing to smelt, which properly form part of the expense of mining the ore, and which therefore should be included in the cost of mining, so that the 6c. per lb. given would be more correctly 9c. per lb. copper.

With these conditions confronting me, I advised a cessation of metallurgical operations until the mine had been developed, and a better grade of ore had been stoped.

All attempts at concentration of the ores failed, the ore being a very intimate mixture of blende and pyrite, which resisted electro-static or magnetic separation. Hand picking, sizing and wet concentration was equally unsuccessful. Even the finely pulverized particles of the ore (100-mesh) showed this intimate blending of the sphalerite and pyrite. It was also noted that the product which may be termed the zinc concentrate contained a larger portion of the copper and silver originally contained in the ore than the pyrite concentrate, which never could be obtained reasonably free of zinc.

I then conducted extensive experiments in roasting the ores, and was satisfied with the success of a special roasting process developed by me for treating the ores profitably, this roasting to be limited to ores containing the largest portion of blende. Incidentally, a portion of the zinc could have been recovered for the manufacture of lithopone. The ultimate success was, of course, based on the provision of ores which contained the essentials, i.e., sufficient copper, gold and silver to insure profitable smelting. These suggestions were not considered by the directors of the company, upon which I resigned, rather than continue unprofitable operations.

HERBERT HAAS.

San Francisco, Cal., March 12, 1908.

Coal-dust Firing of Reverberatory Furnaces

Mr. Shelby's article in the JOURNAL of March 14, recounting his experience with coal-dust firing last year at Cananea, is most interesting to those engaged in smelting or the application of pulverized fuel. As this article is devoted more or less to the consideration of my own letter to the JOURNAL of Feb. 1, I wish to say a few words further on the subject.

The problem of applying powdered coal to a reverberatory furnace may be divided into two parts: (1) the accomplishment of the smelting process and the maintenance of the furnace; and (2) the disposal of the hot gases and flue dust. As long as conditions are maintained in the furnace which satisfactorily carry on

the smelting process, it is obvious that the furnace will not be affected by the method of disposing of the flue gases. To ascertain the advantages of the use of pulverized coal in the furnace itself, it is therefore fair to rule out the troubles which arose in the flues, and the mechanical difficulties such as the wearing away of the charging holes. Mr. Shelby makes the following statements which apply to the furnace when external conditions were favorable and from which it is evident that the smelting operation was successfully carried on with the expected economy and increase in furnace capacity:

"The capacity of the furnace was at once increased when pulverized coal was applied from 100 tons per day to 180 tons per day. In this manner the ashes were fluxed off easily and continuously. Our coal in Cananea runs considerably higher in ash than the coal used in the Anaconda furnace; but in spite of this difference we expect to smelt our flue dust with less than 20 per cent."

The disposal of the flue gases and the dust gave the most serious trouble; but local conditions, such as "a long and tortuous flue," had much to do with this. No doubt Mr. Shelby's present arrangement will permit continuous operation of the furnace, but with the waste of the heat of the escaping gases. If this loss is thought to be of no importance and the gases are discharged directly through a flue or stack, they can be brought below the clinkering temperature of the ash very readily by adding to them just beyond their point of exit from the furnace, a suitable percentage of air drawn into the flue by forced or stack draft. The addition of an equal weight of air to the flue gases will reduce the temperature of the mixture to about one-half that of the flue gases as they escape from the furnace, but a much smaller percentage than this will probably serve the purpose.

Waste-heat Boilers

Mr. Shelby's opinion in reference to the practicability of the waste-heat boilers is, as he states my own to be, a theory, unsupported by any experience. The fact that coal-dust-fired boilers in which the ash was delivered directly to the tubes and in which a very high furnace temperature was reached, have been run for long periods successfully without clogging and the further fact that waste-heat boilers have been used very satisfactorily for some time in connection with reverberatory puddling furnaces fired with coal dust, seem to support my theory of their practicability.

I do not follow the reasoning of Mr. Shelby and that of the Journal, which concludes that the value of the utilization of the waste heat is rendered of less importance by the economy otherwise effected by firing with coal dust. While with pulverized coal a smaller amount of fuel will be burned, still the waste gases passing off at 2500 deg. at least will carry away a large amount of heat which is available for steam generation. Assuming Mr. Shelby's figures of 2½ lb. coal per h.p.-hour to fairly represent the coal used under the boilers in an average smelter plant, the coal required for a horse-power year of 360 days of 24 hours each will cost $43 at $4 per ton. The waste gases from the Cananea furnace burning 55 tons of pulverized fuel daily will generate between 300 and 400 h.p., representing from $12,000 to $15,000 per year at this rate, no negligible item.

The necessity for considering the effect of the ash, however, in the reverberatory, flues, or attached boilers may be very largely eliminated by depositing the major part of the ash before the fuel enters the furnace at all, as has been accomplished in a simple manner in a recent installation for pulverized fuel.

Edward G. Thomas.

New York, March 19, 1908.

The Fire and Wet Assay of Silver Ores

In the Journal of Jan. 1, G. W. Kneisly discusses the relative merits of the crucible, scorification and combination assay of silver ores. It seems to me that with two facts as a guide, this difference should not exist on ordinary native and sulphide ores.

It is well known that the greater the amount of silver cupelled, the smaller will be the percentage of silver loss. Table 1 (compiled from daily control assays, with cupel and slag corrections) illustrates this.

The loss of silver depends in part on the amount of silver present; and, other conditions being equal, the greater the amount of ore taken for assay the higher should be the results. It is also true that, for good crucible silver assays, a flux should contain only sufficient litharge for a button. An excess of litharge gives low results and these are shown in Table 2, which was compiled from averages of 8 to 10 assays on each charge.

Cobalt, Ont. A. Harry Hook.

Feb. 11, 1908.

VARYING RICHNESS OF THE ORE AND QUANTITY OF LITHARGE AFFECT RESULTS.

Table 1.

Silver in Ore. *Mgs.*	Per Cent. of Loss.
33.1	2.23
54.6	1.86
97.7	1.61
148.6	1.48
177.9	1.29
518.9	0.86
939.9	0.72
1648.9	0.70

Table 2.

Weight of Ore Taken.	Litharge *Grams.*	Flux. Borax Na_2CO_3 K_2CO_3 *Grams.*	Silver Recovered. *Ounces.*
½ a.t.	80	20	336.0
¼ a.t.	20	41	340.2
½ a.t.	116	19	336.4
½ a.t.	30.6	65	343.0

Note.—The average of eight scorifications on this sample was 339.1 ounce and the combination method gave 342.6 ounces per ton.

Tube-mill Lining

Bearing upon the discussion which has lately occurred in the Journal and other technical papers as to the priority of the invention of the ribbed, self-forming tube- or pebble-mill lining, a letter which I recently received may be of interest. I have purposely avoided entering more energetically into a discussion of this method of lining tube mills, feeling secure in my knowledge as to recorded dates of invention, use, patents, and application for patents, especially as this matter of dates is now undergoing judicial investigation.

John T. Morrow, president of the American Sapphire Company, writes as follows:

"In January, 1906, while we were discussing plans for extracting sapphires from the ore, you suggested that we try for the purpose a machine made of two cones placed base to base, and further suggested placing on the inside of these cones a series of angle irons, between which would lodge the material being treated, thus forming a protective lining. A machine of this type was constructed and put in place at our mines, the bill from the manufacturer of the machine being dated Feb. 8, 1906. We found that the protective lining scheme worked very satisfactorily. The capacity of the machine was from five to eight tons per hour, and we found that we could control the issue of the material that came from the machine, from a slime or sludge, to as coarse as ⅝ inch."

This should be convincing evidence that I am not unjustly claiming credit for the invention of the self-forming lining.

The oldest date claimed by any inventive competitor is June 13, 1906, while my patent investigation antedates the placing of the order for the conical mill and its ribbed lining referred to by Mr. Morrow. This feature is included in all my foreign patents, not excepting Mexico, where another patent for the same device appears to have been issued more than six months later.

H. W. Hardinge.

New York, March 17, 1908.

Uniformity in size of coal tends to increase the efficiency of combustion.

United States Steel Corporation

Operation of a Corporation Which Made Gross Earnings of $757,014,768 Last Year, and Controls Two-thirds of Our Production

FROM THE OFFICIAL REPORT

The report of this company, just issued, covers the year 1907, and contains, as usual, a full and fair statement of the operations for the year. The report covers much ground and so wide a range of work, that the abstract here presented is necessarily much condensed.

Capital Account

The capital stock remains unchanged at $360,281,100 preferred and $508,302,500 common stock. The bonded and debenture debt is $600,947,081, made up as follows: Fifty-year, 5-per cent. bonds—of which $23,758,000 are held by the sinking fund and deducted from the total debt—$393,057,000; 10-60 year 5-per cent. bonds, $200,000,000; obligations of subsidiary companies, $120,758,081. In addition there are mortgages and purchase money obligations of subsidiary companies amounting to $5,393,941. The sinking and reserve funds amounted on Dec. 31 to $94,479,324, and undivided profits to $122,645,244. Current liabilities amounted to $45,063,825; but they appear small in comparison with $274,411,303 current assets, which include cash, accounts receivable, stocks and materials on hand.

Earnings and Income

The general statement of gross earnings, etc., for 1907 is as follows, very much condensed:

Gross sales and earnings	$757,014,768
Operating expenses	564,166,777
Balance	$192,847,991
Rentals and sundry gains	3,266,209
Income from investments	6,482,741
Total income	$202,596,941
General expenses, taxes, etc.	$25,395,379
Interest on special obligations	6,492,195
Profits not realized, etc.	9,744,693
Total prior charges	$41,632,267
Net earnings for 1907	$160,964,674

The income statement for the year is as follows, also much condensed:

Net earnings, as above	$160,964,674
Depreciation and replacement	$27,719,744
Interest and sinking funds	27,997,850
Adjustment of accounts	681,516
Total charges	$56,399,110
Surplus earnings	$104,565,564
Dividends paid	$35,385,727
Additional property, new plants, etc.	35,500,000
Gary steel plant	18,500,000
Total appropriations	$89,385,727
Undivided profits	$15,179,837
Balance from 1906	79,556,654
Surplus subsidiary companies, etc.	27,908,753
Total surplus, Jan. 1, 1908	$122,645,244

The operating expenses include all current repairs and maintenance of plant, as well as all working expenses. These expenses were 74.5 per cent. of the gross earnings.

The expenditures made by all companies during the year 1907 for maintenance and renewals, including the relining of blast furnaces, and for extraordinary replacements, equaled the total sum of $55,828,253, an increase in comparison with the expenditures for the same purposes during the preceding year of $7,495,163, or 15.5 per cent. The expenditures in the year 1907 were the largest of any year in the organization's history. Of these expenditures $35,503,668 were for maintenance and repairs, and $20,324,585 from the special funds provided for extraordinary replacements and repairs. On Dec. 31 there was a total of $41,360,655 remaining to the credit of the various depreciation and replacement funds.

The operations of the Tennessee Coal, Iron and Railroad Company for November and December, 1907, are included in the statements.

A condensed comparative statement for two years is as follows:

	1906.	1907.	Changes.
Gross earnings	$696,756,926	$757,014,768	I. $60,257,842
Gross income	188 832,790	202,596,941	I. 13,764,151
Net income	156,624,273	160,964,674	I. 4,340,401
Net surplus	98,128,587	104,565,564	I. 6,436,977
Dividends	35,385,727	35,385,727	.....
New property	50,000,000	54 000,000	I. 4,000,000
Final surplus	12,742,860	15,179,837	I. 2,436,977

The appropriations for new property, made from current earnings, represent actual increase of the assets and earning power, and are really expenditures on capital account. It will be observed that these appropriations exceed the dividend payments. The dividends paid were 7 per cent. on the preferred and 2 per cent. on the common stock in each year.

Production

The production of the several properties for the year, exclusive of that of the Tennessee Coal, Iron and Railroad Company, in comparison with the results for 1906, was as follows, in long tons, except cement, which is in barrels:

Products.	1906.	1907.
Iron Ore Mined—		
From Marquette Range	1,442,290	1,170,496
From Menominee Range	1,874,680	1,625,358
From Gogebic Range	1,465,375	1,425,457
From Vermilion Range	1,794,186	1,724,217
From Mesabi Range	14,068,617	16,458,273
Total	20,645,148	22,403,801
Coke Manufactured	13,295,075	12,373,938
Coal Mined, not including that used in making Coke	1,912,444	1,841,259
Limestone Quarried	2,227,436	2,957,163
Blast Furnace Products—		
Pig Iron	11,058,526	10,631,620
Spiegel	150,044	130,554
Ferro-Manganese and Silicon	58,807	57,794
Total	11,267,377	10,819,968
Steel Ingot Production—		
Bessemer Ingots	8,072,655	7,556,460
Open-Hearth Ingots	5,438,494	5,543,088
Total	13,511,149	13,099,548
Rolled and Other Finished Products for Sale—		
Steel Rails	1,982,042	1,733,814
Blooms, Billets, Slabs, Sheet and Tin Plate Bars	1,096,727	758,699
Plates	836,399	877,682
Heavy Structural Shapes	620,823	587,954
Merchant Steel, Skelp, Hoops, Bands and Cotton Ties	1,240,548	1,316,387
Tubing and Pipe	1,025,913	1,174,629
Rods	111,488	126,095
Wire and Products of Wire	1,399,717	1,481,226
Sheets—Black, Galvanized and Tin Plate	1,112,542	1,070,752
Finished Structural Work	643,622	719,887
Angle and Splice Bars and Joints	176,730	195,157
Spikes, Bolts, Nuts and Rivets	70,233	67,991
Axles	181,913	189,006
Sundry Iron and Steel Products	79,736	77,463
Total	10,578,433	10,376,742
Spelter	28,884	31,454
Copperas (Sulphate of Iron)	21,933	24,540
Universal Portland Cement, bbl	2,076,000	2,129,700

During the first six months of 1907 orders for steel products were received equaling substantially the maximum capacity of the mills. Subsequently there was a marked falling off in the new business offered. As a result the tonnage of unfilled orders on the books at Dec. 31, 1907, was only 4,624,553 tons of all kinds of manufactured steel products. In common with other lines of industry there was a material reduction in sales during the latter part of 1907. However, the bookings for January were 25 per cent. better than December, and for February 25 per cent. better than January.

Employees and Pay-rolls

The average number of employees in the service of all companies during the fiscal year of 1907, is comparison with the year 1906, was as follows:

Employees of—	1906.	1907.
Manufacturing properties	147,048	151,670
Coal and coke properties	21,929	21,447
Iron ore mining properties	14,393	16,462
Transportation properties	16,638	18,133
Miscellaneous properties	2,449	2,468
Total	202,457	210,180
Total annual salaries and wages	$147,765,540	$160,825,822

On Jan. 1, 1907 (on March 1, 1907 in case of the coke companies), an advance was made in the wages and salaries of ap-

proximately 65 per cent. of the total employees of all companies. This advance increased the wages and salaries of the employees affected about 6.6 per cent. The average rate of wages and salaries paid all employees during 1907 was above 5 per cent. higher than the similar average rate in 1906.

In January, 1908, there was again offered to the employees of the United States Steel Corporation and of the subsidiary companies the privilege of subscribing for 25,000 shares of preferred stock on substantially the same conditions as offered previously, except the price was fixed at $87.50 per share. The offer was over-subscribed by about 100 per cent., applications having been received from 24,884 employees for an aggregate of 50,075 shares. Allotments were made as follows: Each subscriber for one share was allotted the same, and all others were allotted 50 per cent. of their subscriptions. The total number of shares allotted on this basis was 30,621.

Reference was made a year ago to the proposal to establish from the employees' bonus fund for 1907 a separate fund to be used for pension purposes. Accordingly the sum of $1,000,000 was reserved for this purpose. The plan under which the benefits for the pension fund will be extended to employees is under consideration.

The Tennessee Purchase

In November, 1907, the corporation acquired $30,374,825, par value, of the common stock, and of common stock subscription receipts of the Tennessee Coal, Iron and Railroad Company, being all but $220,160 of the total. Of this foregoing aggregate of $30,374,825, par value, $29,742,170 were purchased at par, the corporation delivering in payment therefor its 10-60-year 5-per cent. sinking fund gold bonds, as the equivalent of cash, at the rate of $11,904.76, par value, of said bonds for $10,000, par value, of Tennessee common stock; the balance of $632,655 of said stock acquired was paid for in cash, being the installment of 20 per cent. payable Dec. 15 on the stock subscription receipts. The total cost to the corporation of the stock acquired as above was $35,317,635. Of the bonds delivered as above, $30,000,000 were bonds of this issue held in the corporation's treasury, which had been executed in 1903. The balance of the bonds delivered for the purpose aforesaid was acquired through purchase in the open market.

During the year 1907 the production of the mineral and manufacturing properties of the Tennessee Company was as follows: Iron ore, 1,576,757 long tons; limestone and dolomite, 244,059 long tons; coal, not including that used in making coke, 1,709,251 short tons; coke, 1,170,826 short tons; pig iron, 602,827 long tons, of which 287,354 tons were for conversion into steel, and 315,573 for market; open-hearth steel ingots, 243,444 long tons; steel rails, 146,171 tons; billets, plates and bars, 88,009 tons.

The net profits for the Tennessee Coal, Iron and Railroad Company for the year 1907, after charging off $437,667 for depreciation and extraordinary replacements, and $885,552 for net interest charge on bonded and floating debt, were $1,426,684. Extensive outlays were made during the year for construction and improvement work. The total amount expended aggregated $6,589,117. Large further outlays are now being made on improvements of the property, especially the steel plant.

General Conditions

During the first 10 months in the year 1907 the several departments of the subsidiary companies were operated at substantially their maximum capacity. The production by the manufacturing properties of finished products for sale during the period from Jan. 1 to Nov. 1, 1907, showed an increase of 5 per cent. over the corresponding period in 1906. Owing, however, to the sudden and severe check to general trade conditions which took place in the fall of 1907, the volume of business of the subsidiary companies was materially curtailed, resulting during the last two months of the year in a decrease in production of finished products which exceeded the gain made during the preceding 10 months. The production of finished steel products for sale in the entire year of 1907 shows a decrease compared with 1906 of 201,691 tons, or about 2 per cent. The decrease in actual shipments of products made to customers showed a somewhat larger falling off, 10,451,488 tons of all kinds of manufactured materials (including furnace products and scrap) having been shipped in 1907, against 10,862,425 tons in the preceding year. Prices of steel commodities for domestic sale were not generally advanced during the year, notwithstanding there were marked increases in the cost of raw materials and supplies used in manufacturing, in railroad freight charges, in wages and in taxation charges.

The satisfactory results obtained from the export business through the building up of a permanent and continuous export trade, as noted in previous reports, have continued. During the year there were shipped for export 1,014,082 tons of steel commodities of various kinds, a decrease of 6 per cent. as compared with the shipments in the previous year. The gross receipts for the 1907 shipments, however, exceeded those for 1906 by 16 per cent. The average mill price per ton received for all exported materials was only 7½ per cent. less than the average price received for all domestic shipments. The advantages to the employees, the domestic consumer, and the manufacturer, of a fair volume of foreign trade during periods of business depression in the United States, have been emphasized in previous reports. In order to obtain the maximum benefits from such trade during times of lesser activity in business in the domestic market, it seems wise to sell continuously in the neutral markets of the world, and even at times when foreign trade conditions do not result in prices so near the domestic prices as were received during 1907.

In November, 1907, the corporation acquired a majority of the common stock of the Tennessee Coal, Iron and Railroad Company as is set forth in detail above. The property is very valuable. Its mineral resources are large. The location of the iron ore and coal deposits in the immediate proximity of the manufacturing plants enables the production of iron at reasonable cost. It is believed the lines of business of the Tennessee company can be materially extended.

Substantial progress was made during the year in the construction of the new plant at Gary, Ind., the building of the city of Gary, and in the terminal railroad work and facilities adjacent to the steel plant. The expenditures made in connection with the foregoing to Dec. 31, 1907, including the cost of about 9000 acres of land, amounted to $24,063,388. This amount has been provided entirely from surplus net profits of the corporation. At Dec. 31, 1907, there was reserved in the special fund set aside and available for the foregoing construction work a balance of $26,051,242. The balance unexpended at Jan. 1, 1908, on appropriations heretofore authorized for this work was $35,517,000. It is believed about $18,000,000 of this amount can be expended during 1908.

There has been purchased a site containing about 1580 acres (of which 300 acres are now submerged) located in St. Louis county, Minn., 10 miles from the center of the city of Duluth, on which it is proposed to construct a moderate-sized iron and steel plant. The tract fronts on the St. Louis river, which is navigable for large lake steamers, and is located on the line of the Northern Pacific Railway. It is expected, however, that there will be constructed in connection with the steel plant a belt railway extending northwardly to a connection with the Duluth, Missabe & Northern Railway, to enable the prompt and economical delivery of ore to the plant from the Minnesota ore ranges; also eastwardly from the steel plant across the St. Louis river into Superior, Wis., where connections will be made with five trunk lines of railways reaching the head of lake Superior from the south and west. It is proposed to have the plant constructed by the Minnesota Steel Company, a subsidiary corporation. The plans for the scope and construction of the steel plant have not yet been fully developed. The expenditures on account of this property during 1907 include the purchase of the real estate and some clearing and leveling of the site.

The Western Bituminous Agreement

SPECIAL CORRESPONDENCE

The miners' convention at Indianapolis, after waiting in vain for some response from the operators, finally abandoned the plan for a renewal of the Interstate agreement, and consented to a renewal of the district contracts for one year only. This was done, however, without withdrawing from the position in favor of the general agreement, the agitation for which will, apparently, be renewed as soon as possible.

The scale committee of the United Mine Workers of America to which was referred the question of deciding the plan of action by the delegates assembled in extraordinary convention in Indianapolis, recommended that separate district conferences be asked for between the miners and operatives in the Central competitive States. The committee also recommended that separate wage conferences be held in the districts of the Southwestern competitive district; that the scale adopted in each instance be not less than the present existing scale, and that in case of a failure to complete negotiations a suspension of work be called until contracts extending beyond April 1 be signed.

This report of the committee came after five days of deliberation and waiting for favorable replies from the operators of the central competitive States. The report was adopted and the extraordinary convention adjourned.

The salient features of the policy adopted by the convention, are: That settlement be made with the operators by districts; that contracts be for only one year; that present wage rates in each district be the minimum on which a new contract can be made; that in districts in which negotiations for a new contract are in process April 1, the miners will continue at work pending settlement, and that if districts fail to obtain a contract before the present one expires, the question of making contracts by other methods shall be left in the hands of the national executive board and the districts affected.

A motion was made to continue work under the present scale through April, but if an interstate agreement is not reached by May 1, mining in the entire competitive field be discontinued was almost unanimously voted down.

With the adjournment of the miners' convention the interest at once centered in the various soft-coal districts where conferences are being called by the miners and operators to arrange a contract for the year's work. The first meeting has been called by Indiana operators for March 24, but it is known that a number of Indiana operators will insist on waiting until after April 1, to learn whether President Lewis will start a new movement toward the rehabilitation of the interstate agreement.

The Miami Copper Company

A mining flotation of some interest, which will shortly be made, is that of the Miami Copper Company, a property in the Clifton district in Arizona. In this case a radical departure is to be taken from the methods usual in this country, with properties of this class. The English method of advertising the company extensively in the daily papers and selling the stock directly to the public will be adopted. This plan is in use here by bankers, in case of large and important bond issues, but has not been usual with mining stocks of standing.

This flotation—experimental it may be called—will be watched with some interest. Another point to be noted is that the managers evidently think that we are so far on the return to prosperity that investors are likely to come forward on a good opportunity.

George G. Convers

BY A. B. DE SAULLES

The death of George G. Convers, on March 6 at Naples, Italy, ended the earthly career of a gifted and useful man, and to me it is a loss of a strong friend and colleague. Associated with him for 20 years, I learned to admire his unselfish friendship, his strong points, and his thorough knowledge of all that pertained to the metallurgy of zinc and its associated branches.

Born 53 years ago at Zanesville, Ohio, and decended from the first white male child born in Ohio, in his early youth he attended the schools of his town; he then went to Phillips Academy, Andover, Mass., to be prepared for Lehigh University, entering the class of 1877.

On leaving Lehigh University, he was appointed as an assayer in New Orleans' Mint. Leaving the Mint, he accepted a position as chemist on a sugar plantation, from which position he was called in June, 1881, to take charge of the laboratory of the Lehigh Zinc and Iron Company, and while in its laboratory, introduced quick and new methods for the determination of zinc and lead. He was soon promoted to superintendent, and held that position until the consolidation with the New Jersey Zinc Company, at which time he was appointed general superintendent, and this position he held at his death.

During his administration of the Lehigh Zinc and Iron Company, he introduced many new processes and improvements, too numerous to mention. The most important was the development, in 1894, of the magnetic separation of franklinite, and from his process, the Wetherill magnetic separator was evolved. Convers deserves the credit of having made the first step toward solving the problem of using willemite from the New Jersey ores for the manufacture of spelter, with the separation of a clean franklinite for the manufacture of zinc oxide and the resulting residuum for the manufacture of a high grade speigeleisen.

His administrative success was due to his courtesy, self control and thorough knowledge of all matters under his charge, and through these attributes he won the respect and confidence of all who were associated with him. His loss to all of us will be irreparable, and as a friend wrote to me a few days since, "I am sure you will miss him more and more as the years roll on."

Meerschaum in New Mexico

Two deposits of meerschaum have been located in the upper Gila river valley, one about 23 miles east of north of Silver City, the other at a mine about 12 miles northwest of Silver City. According to Douglas B. Sterrett, of the United States Geological Survey, who visited the mine in October, 1907, the deposit lies in the bottom and walls of the cañon of Bear creek, occurring in veins, lenses, seams, and balls in limestone in both nodular and massive form. The nodular meerschaum thus far tested contains iron stains and particles of grit and is inferior to the meerschaum of Asia Minor. The more compact, massive material may perhaps be found free from stains and of better quality.

Erratum

In the article, "The Merits and Demerits of Air-hammer Drills," by G. E. Wolcott, this JOURNAL, Feb. 15, p. 351, the last sentence of the first paragraph of the third column, "This is also true regarding a hole reamed by a bull bit," should read, "This is also true of the bull bit." The bull bit, as well as the cross-bit with the rounded edge, can be used to ream out holes that have been rifled by a square bit.

The strontianite mines in the Dortmund district of Prussia were somewhat depressed in 1906, owing to the Russian political situation, which led to a considerable decrease in the demand from that country. The total output was 700 tons, and the sales 982 tons, of which 387 tons went to Russia. The average selling price for strontianite was about $390 per ton, as compared with $420 in 1905.

Patents Relating To Mining and Metallurgy

A Selected and Classified List of New Inventions Described during the Past Month in the Publications of the Patent Offices

UNITED STATES AND BRITISH PATENTS

A copy of the specifications of any of these patents issued by the United States Patent Office will be mailed by THE ENGINEERING AND MINING JOURNAL upon the receipt of 25 cents. British patents are supplied at 40 cents. In ordering specifications, correspondents are requested to give the number, name of inventor and date of issue.

ANTIMONY

ORE TREATMENT—Process of Treating Ores. John Patten and Charles R. Barnett, Baltimore, Md. (U. S. No. 880,752; March 3, 1908.)

ARSENIC

ORE REDUCTION—Process of Reducing Arsenical Ores. Gustaf M. Westman, New York, N. Y. (U. S. Nos. 879,931 and 879,932; Feb. 25, 1908.)

BISMUTH

ORE TREATMENT—Process of Treating Ores. Stanley C. C. Currie, Los Angeles, Cal. (U. S. No. 881,101; March 3, 1908.)

BROMINE

PURIFYING PROCESS—Process of Removing Chlorine From Raw Bromine. Konrad Kubierschky, Brunswick, Germany. (U. S. No. 881,806; March 10, 1908.)

COAL AND COKE

ARTIFICIAL FUEL—Production of Artificial Fuel and Coke. Hugh S. Robertson and John R. Graham, Walthamstow, England, assignors to Robfrey & Company Limited, London, England. (U. S. No. 877,738; Jan. 28, 1907.)

BRIQUET—Fuel-briquet. August M. Mannewitz, Dallas, Tex. (U. S. No. 881,192; March 10, 1908.)

COKE—Manufacture of Coke. John H. Hilliman, Pittsburg, Penn. (U. S. No. 881,685; March 10, 1908.)

SCREENING — Apparatus for Screening and Grading Coal. William R. Garrett and James H. Walker, Central City, Ky. (U. S. No. 879,625; Feb. 18, 1908.)

COPPER

ELECTROLYTIC TREATMENT—Method of Recovering Copper from Ore or Matte by Electrolysis. Henry K. Hess, Philadelphia, Penn. (U. S. No. 881,580; March 10, 1908.)

REDUCTION—Process for the Reduction of Copper Ore. Louis Durand, Dumont, N. J., assignor of one-fifth to Ruben O. Currie, New York, N. Y. (U. S. No. 879,530; Feb. 18, 1908.)

SMELTING-FURNACE for Copper and Other Ores. Henry H. Freeman, Wilkinsburg, Penn. (U. S. No. 879,623; Feb. 18, 1908.)

GOLD AND SILVER

AMALGAMATOR. James M. Barnes, Idaho Springs, Colo., assignor, by mesne assignments, to The Barnes Mining, Milling and Machinery Company, Denver, Colo. (U. S. No. 879,999; Feb. 25, 1908.)

CYANIDATION—Process of Extraction. James E. Porter, Syracuse, and Arthur L. Clark, New York, N. Y., assignors to Just Mining and Extraction Company, a Corporation of New York. (U. S. No. 880,821; March 3, 1908.)

FILTER PRESSING—Method of Removing Caked Material from Pressure-filters. David J. Kelly, Salt Lake City, Utah, assignor to The Kelly Filter Press Company, Salt Lake City, Utah, a Corporation of Utah. (U. S. No. 880,742; March 3, 1908.)

FILTERING APPRATUS. Harry P. Taylor, Salt Lake City, Utah. (U. S. No. 880,426; Feb. 25, 1908.)

GOLD-CONCENTRATING APPARATUS. Edmond R. Cook, Portland, Ore., assignor of one-half to Frank Anthony, Portland, Ore. (U. S. No. 880,631; March 3, 1908.)

IRON AND STEEL

MANUFACTURE of Steel by the Pneumatic Process. Alexandre Tropenas, Montelimar, France. (U. S. No. 880,253; Feb. 25, 1908.)

PUDDLING FURNACE—Oscillating Puddling-furnace. James P. Roe, Pottstown, Penn. (U. S. No. 881,342; March 10, 1908.)

NICKEL AND COBALT

COMPLEX ORE TREATMENT—Process for Treating Complex Cobalt Ores and for Refining Cobalt from Nickel, Arsenical and Silver-bearing Ores. Ernest E. Armstrong, Niagara Falls, N. Y. (U. S. No. 881,527; March 10, 1908.)

ORE TREATMENT—Process of Treating Metallic Ores or Mattes. Emil Günther and Rudolf Franke, Eisleben, Germany. (U. S. No. 879,633; Feb. 18, 1908.)

RARE METALS

EXTRACTION OF URANIUM AND VANADIUM—Process of Extracting Uranium and Vanadium From Ores. Herman Fleck and William G. Haldane, Golden, and Edwin L. White, Denver, Colo. (U. S. No. 880,645; March 3, 1908.)

ZINC

METALLURGY of Ores of Zinc, etc. Franz Meyer, Englewood, N. J., assignor to Metallurgical Company of America, New York, N. Y., a Corporation of New Jersey. (U. S. No. 879,482; Feb. 18, 1908.)

SULPHIDE ORE TREATMENT—Treatment of Complex Sulphide Ores, Containing Lead and Zinc. Guy de Bechi, London, England, assignor of one-half to Reginald Wynn Rucker, London, England. (U. S. No. 880,775; March 3, 1908.)

ZINC RETORT RESIDUES—Process of Treating Zinc-retort Residues. Gustav Stolzenwald, Valea Calugareasea, Rumania. (U. S. No. 881,355; March 10, 1908.)

MINING—GENERAL

DREDGING—Means for Advancing Dredgers. Robert M. Wilson, San Francisco, Cal. (U. S. No. 879,345; Feb. 18, 1908.)

PROP for Mines. Friedrich Nellen and Albert Voigt, Essen, Germany. (U. S. No. 881,609; March 10, 1908.)

ORE DRESSING

CENTRIFUGAL ORE-SEPARATOR. Philip F. Peck, Chicago, Ill. (U. S. Nos. 879,893 and 879,894; Feb. 25, 1908.)

CONCENTRATOR—Dry Ore-concentrator. Joseph Hubert, Reno, Nev. (U. S. No. 880,995; March 3, 1908.)

CONCENTRATOR—Mineral - concentrator. Charles O. Michaelsen, Omaha, Neb. (U. S. No. 880,808; March 3, 1908.)

CRUSHING-MILL. Frank A. Huntington, San Francisco, Cal. (U. S. No. 879,175; Feb. 18, 1908.)

ORE-CONCENTRATOR. Edwin M. Jahraus, Dayton, Ohio. (U. S. No. 879,104; Feb. 11, 1908.)

ORE-CONCENTRATOR. Ray H. Manley, San Francisco, Cal. (U. S. No. 880,013; March 3, 1908.)

ORE-DRESSING MACHINERY — Disintegrating, Washing, and Screening Machine. Charles B. C. Storey, Lancaster, England. (U. S. No. 881,207; March 10, 1908.)

ORE-SEPARATING APPARATUS. Thomas Veitch, New York, N. Y., assignor to International Patent Corporation, Jersey City, N. J., a Corporation of South Dakota. (U. S. No. 880,430; Feb. 25, 1908.)

ORE-SEPARATOR. James R. Yount, Nyssa, Ore. (U. S. No. 881,526; March 10, 1908.)

PULVERIZER — Centrifugal - impact Dry Pulverizer. Louis C. Graupner, San Francisco, Cal. (U. S. No. 878,878; Feb. 11, 1908.)

SEPARATION of Metalliferous Minerals from Gangue. Henry L. Sulman, Hugh F. Kirkpatrick-Picard, and John Ballot, London, England. (U. S. No. 879,985; Feb. 25, 1908.)

METALLURGY—GENERAL

ELECTRIC-FURNACE PROCESS. Franz von Kügelgen and George O. Seward, Holcombs, Rock, Va., assignors to Virginia Laboratory Company, New York, N. Y., a Corporation of New York. (U. S. No. 880,743; March 3, 1908.)

ELECTROLYSIS—Producing Metals by Electrolysis. George O. Seward and Franz von Kügelgen, Holcombs Rock, Va., assignors to Virginia Laboratory Company, New York, N. Y., a Corporation of New York. (U. S. No. 880,760; March 3, 1908.)

ORE TREATMENT—Method of Reducing Ores. John T. Jones, Iron Mountain, Mich., assignor of one-half to George A. St. Clair, Duluth, Minn. (U. S. No. 880,799; March 3, 1908.)

ROASTING AND SINTERING PROCESS—Process of Roasting and Sintering Ores. Arthur S. Dwight and Richard L. Lloyd, Cananea, Mexico. (U. S. No. 882,518; Mar. 17, 1908.)

SINTERING PROCESS—Process of Treating Ores. Arthur S. Dwight and Richard L. Lloyd, Cananea, Mexico. (U. S. No. 882,517; March 17, 1908.)

SMELTER SMOKE—Fume-Arrester. Selden I. Clawson, Salt Lake City, Utah. (U. S. No. 880,506; March 3, 1908.)

MINING MACHINERY AND APPARATUS

BLASTING-FUSE IGNITER. Benjamin F. Pearson, Canyonville, Ore. (U. S. No. 881,714; March 10, 1908.)

CONVEYING—Apparatus for Conveying and Discharging Ores, etc. Peter Paton, London, England. (U. S. No. 880,091; Feb. 25, 1908.)

DRILL—Pneumatic and Other Drill. Martin Hardsocg, Ottumwa, Iowa. (U. S. Nos. 880,880 and 880,881; March 3, 1908.)

HOISTING APPARATUS for Dredgers and the Like. Robert M. Wilson, San Francisco, Cal. (U. S. No. 881,838; March 10, 1908.)

ORE-CAR. Charles L. Pennell, Canal Dover, Ohio, assignor of one-half to Charles Wagner, Canal Dover, Ohio. (U. S. No. 881,146; March 10, 1908.)

ROCK-DRILL. Bradford H. Locke, New York, N. Y. (U. S. No. 879,971; Feb. 25, 1908.)

METALLURGICAL MACHINERY AND APPARATUS

BRIQUETTING MACHINERY—Press for Manufacturing Briquets, Blocks, Artificial Stone, and the Like. Wilhelm Surmann, Cologne, Germany. (U. S. No. 881,164; March 10, 1908.)

ELECTRIC FURNACE ELECTRODE—Sectional Electrode for Electric Furnaces. Charles E. Wilson, Ferris, W. Va. (U. S. No. 881,520; March 10, 1908.)

ELECTRIC FURNACE ELECTRODE-HOLDER. Electrode-Holder for Electric Smelting-Furnaces. Charles E. Wilson, Ferris, W. Va. (U. S. No. 881,519; March 10, 1908.)

ELECTRIC FURNACES—Construction of Induction Electric Furnaces. Gustave Gin, Paris, France. (U. S. No. 875,801; Jan. 7, 1908.)

METALLURGICAL FURNACE. Franz Meyer, Englewood, N. J., assignor to Metallurgical Company of America, New York, N. Y., a Corporation of New Jersey. (U. S. No. 879,483; Feb. 18, 1908.)

ORE ROASTING—Furnace for Roasting Ores. Alva D. Lee, Brookline, Mass. (U. S. No. 879,483; Feb. 18, 1908.)

REVERBERATORY FURNACE. Frank Cotton, Hornsby, New South Wales, Australia. (U. S. No. 881,110; March 10, 1908.)

ROASTER. Walter G. Swart, Denver, Colo. Original application filed Feb. 25, 1905, Serial No. 247,211. Divided and this application. (U. S. No. 879,842; Feb. 18, 1908.)

SMELTING-FURNACE with Oil Fire. August Koch, Hanover-List, Germany. (U. S. No. 876,275; Jan. 7, 1908.)

SMOKE AND FUME CONDENSER. James T. Yates and John Devey, Lehi and William B. Richan and Walter A. Devey, American Fork, Utah, assignors of one-eighth to Elisha H. Boley, American Fork, Utah. (U. S. No. 879,023; Feb. 11, 1908.)

Personal

Mining and metallurgical engineers are invited to keep THE ENGINEERING AND MINING JOURNAL informed of their movements and appointments.

Samuel Newhouse has returned to Salt Lake City from a European trip.

Harry S. Joseph has resigned the position of secretary of the Utah Mine-Owners' association.

G. P. Stalford, of Sayre, Penn., has been in Boulder county, Colo., looking after mine and milling interests.

Edward R. Zalinski has returned to Salt Lake City, from examining mining property near Fay, Lincoln county, Nevada.

William Loach, manager of the Wolftongue properties near Cardinal, Colo., has been making a business visit to the East.

Frederick S. Harris, of Goldfield, Nev., is prostrated with typhoid fever at the Agnew Sanitarium at San Diego, California.

R. W. Foote, a Georgetown, Colo., mining man, is making a trip to Kansas City and other Eastern points, on mining business.

O. B. Thompson, manager of the Fifty Gold Mines Corporation, operating in Gilpin county, Colo., is making a business visit to New York City.

J. H. Vanderberger, a mining engineer, of Grand Rapids, Mich., has been making an examination of property near Hesse, Colo., in the interests of Eastern investors.

Lieut-Gov. Dunsmuir, of British Columbia, is negotiating with an English syndicate for the sale of his extensive coal mines and mineral lands in Vancouver island.

L. C. Graton has recently returned to Washington from field work in Shasta county, Cal., where he completed his examinations of the copper deposits of the region.

Frank A. Keith, for four years past manager of the Tonopah Mining Company at Tonopah, Nev., has resigned and will go to California as soon as his affairs are settled.

E. C. Sullivan has resigned his position in the chemical laboratory of the U. S. Geological Survey to organize a research laboratory for the Corning Glass Works, Corning, New York.

R. Kent, formerly superintendent of the Bessemer Rolling Mill, Bessemer, Ala., has been appointed superintendent of the Tennessee Coal, Iron and Railroad Company's mill at Ensley.

Hon. C. B. Ward, Col. L. C. Paddock, and George W. Teal, all of Boulder, Colo., left there recently for Hermosillo, Mexico, intending to go to Escalante to look after large mining interests.

George C. Kaufman has been appointed general manager of the mining department in Mexico of the American Smelting and Refining Company; also of the American Smelters' Securities Company.

Prof. John Joseph Thomson, of Cambridge, England, has been selected by the Council of the British Association for the advancement of science as president of the annual meeting to be held at Winnipeg in 1909.

Sir W. Armstrong, of London, England, is in the Sudbury district in Ontario, investigating the nickel deposits on behalf of extensive British interests, in connection with obtaining a supply of nickel for armor-plate.

D. A. Karr has severed his connection with the Goshen Iron Company as manager of the Rich Patch ore mines, of Virginia, to accept a similar position with the Earlston and Saxton furnaces at Catoctin, Maryland.

Hugh Rose, assistant general superintendent of the American Smelters' Securities Company, is first assistant to Cortlandt E. Palmer in the management of the properties of the Guanajuato Development Company in Guanajuato, Mex.

F. B. Weeks, who has been connected with the U. S. Geological Survey for the past 18 years, has recently resigned. His address for the next three months, while completing certain reports for the Survey, will be 1201 Euclid street, Washington.

Waldemar Lindgren, in charge of the U. S. Geological Survey work on metalliferous mineral deposits, is just leaving Washington for a month's trip through California, Nevada and Utah, in connection with geological and statistical work.

The Franklin Institute, Philadelphia, has awarded to Dr. Allerton Seward Cushman, of the Public Roads Bureau of the Department of Agriculture at Washington, the Edward Longstreth medal of merit, in recognition of his researches on the corrosion of iron and steel.

H. J. Baron has resigned his position as associate editor of *Mining Science,* of Denver, his resignation taking effect April 1. Mr. Baron was with the *Mining Reporter,* the predecessor of *Mining Science,* for four years as associate editor in the field, and one year as editor.

A. C. Spencer and F. L. Hess, of the U. S. Geological Survey have been on a short trip in the Tye river region of Virginia, examining rutile deposits, used in connection with steel hardening. They were accompanied in the investigations by Virginia State Geologist, Thomas L. Watson.

G. B. Shipley, engineer of the Allis-Chalmers Company's mining machinery department, is in Goldfield, Nev. where he, in conjunction with J. B. Fleming for the Goldfield Consolidated Mines Company, is preparing the plans for the 100-stamp mill to be erected by the latter company at Goldfield.

The Republic Iron and Steel Company, announces the following appointments: J. W. Deetrick, general superintendent of blast furnaces and steel works, with headquarters at Youngstown, Ohio; T. R. Akin, general superintendent of rolling mills, with headquarters at Pittsburg; Frank L. Brown, chief clerk, at Pittsburg.

S. W. Eccles has been elected vice-president of the American Smelting and Refining Company; also of the American Smelters' Securities Company. He will have general charge of all the mines and mills of the two companies. The traffic department of the Smelting Company, formerly under the management of Mr. Eccles, has been turned over to W. M. Sproule.

The field statistical work of the U. S. Geological Survey has this year been extended by the assignment of C. E. Siebenthal to the work of gathering statistics of mine products in the Mississippi valley. He will also take up the statistical work on the production of lead and zinc in the United States. The work on the production of quicksilver will hereafter be conducted by W. D. McCaskey.

W. H. Blackburn has been appointed superintendent of the Tonopah Mining Company at Tonopah, Nev., and will have complete charge of the mining department; A. R. Parsons will take charge of the milling department. W. W. Charles has been appointed comptroller and will have full charge of the financial end of the company at Tonopah. These gentlemen have been with the company for some time.

Cortlandt E. Palmer, connected with the Guggenheims for the past five years in charge of mine and mill construction and operation in the United States and Mexico, has modified his arrangement with these interests. Mr. Palmer will act in future in an advisory capacity to the American Smelters Securities Company, without field work, and will continue in charge of Esperanza Mining Company operations as vice-president and consulting engineer. In addition to the above, Mr. Palmer has accepted the appointment of general manager of the Guanajuato Development Company, operating the Peregrina and Pinguico mines and mills and a number of allied enterprises at Guanajuato, Mexico, his headquarters being at 40 Wall street, New York.

Obituary

Jawood Lukens, who died in Conshohocken, Penn., March 10, aged 65 years, came of an ironmaking family, his grandfather having been one of the earliest ironmakers in the Schuylkill valley. He was educated in Philadelphia, and after working for a time with Alan Wood &

Co., he acquired an interest in the firm, but in 1881 withdrew and started the Longmead Iron Company, of which he was president until his death. Under his management the company acquired the Conshohocken Tube Works, and built up a large business. He was a member of the American Institute of Mining Engineers, the Engineers' Club of Philadelphia, the Franklin Institute, the Union League, the Art Club and the Manufacturers' Club.

Oliver L. Garretson died at his home in Buffalo, N. Y., March 18. While he had suffered from acute indigestion for several years, it was not until three weeks ago that he left New York for his home to take a much needed rest, but he failed to recover his health. Mr. Garretson was born in 1843 in the State of Ohio, and leaves his wife, three sons and two daughters. He came from a line of inventors, his grandfather having been the first inventor of a nail-making machine in this country; Mr. Garretson held the original patent, signed by President Washington. He first engaged in the hardware foundry and manufacturing business, making specialties of his own invention; later he founded the Buffalo School Furniture Company. He went into the manufacture of hardwood lumber, and the plant which he built at Austin, Penn., was at the time said to be the largest and best equipped mill of the kind in the world. In 1890 he became a mineowner, having purchased the Sahauripa mine at Sahauripa, Mexico. Not finding any suitable apparatus on the market, for reducing the ores in this mine, he undertook to devise a furnace which would treat sulphide ores and do the work economically, utilizing the sulphur in the ore for fuel. This invention will be what he is best remembered by, besides his kindness of heart and magnanimous disposition, which endeared him to the hearts of his business and social acquaintances. The Garretson process, for reducing sulphide ores at one operation, he patented in most countries where mining operations are carried on. The invention was tested at a plant built for this purpose at Ore Knob, N. C., some time ago. He organized a company last summer for the purpose of establishing smelting plants, known as the Garretson Smelters, of which company he was president. He was an indefatigable worker, and it is to be regretted that he did not live to see the results of his 10 years labor in the field of metallurgy, or to realize the results from this invention.

Societies and Technical Schools

South Dakota School of Mines—In this school at Rapid City, recently, an interesting test run was made by blowing in a blast furnace and a Bruckner reverberatory furnace, both operated by electric motors. Lead-antimony, copper, iron and fluxing ores were treated and reduced.

American Society of Mechanical Engineers—This society, with the desire to still further develop its publications, has secured Lester G. French to direct the editorial department. Among the immediate improvements to be undertaken is the establishing of departments in the monthly *Proceedings*, thus providing a greater variety of technical articles of interest. All papers, however, will first be presented and discussed before the society at its meetings, as formerly.

The next monthly meeting of the society will be held in the Engineering Societies Building, New York, April 14. The general subject of the meeting is the Conservation of our Natural Resources.

American Electrochemical Society—The thirteenth meeting will be held April 30 at Albany, May 1 at Schenectady and May 2 at Troy, N. Y. At Schenectady an inspection will be made of the General Electric Company's plant. The following papers have been promised:

Corrosion of Iron from the Electrochemical Standpoint, C. F. Burgess.

The Electrochemistry of Light, Dr. Wilder T. Bancroft.

Conduction in Electrolytes, L. Kahlenberg.

Mercury Cathodes in Nitric Acid Solutions, J. A. Wilkinson.

Copper Anodes in Chloride Solutions, Paul Dushman.

The Potential of the Nickel Electrode, E. P. Schoch.

Solubility Determinations in Aqueous Alcoholic Solutions, A. Seidell.

Industrial Applications of Aluminum, E. Blough.

Power for Electrochemical Industries, J. Meyer.

Electrical Conductivity of Graphite, W. Acheson Smith.

Distillation of Turpentine in an Electric Furnace, F. S. Snyder.

Mathematics of the Induction Furnace, E. F. Roeber.

The Synthesis of Hydrocyanic Acid in the Electric Furnace, R. S. Hutton.

Industrial

The Hamilton Steel and Iron Company has completed its new blast furnace at Hamilton, Ont., and is operating the works to their full capacity.

The plant of the Morgan Spring Company, of Struthers, O., has been bought by the Youngstown Sheet and Tube Company. The mill is to be improved and enlarged.

The Central Iron and Steel Company, Harrisburg, Penn., has started its No. 2 blast furnace after an idleness of several months. The company has also put some of its open-hearth steel furnaces at work after a shutdown since December.

The Republic Iron and Steel Company is doing a large amount of new and repair work at its mines near Bessemer, Ala. It is estimated that $60,000 will be expended. Two new hoist houses have been erected and engines placed, the engines being 450 h.p. Two seams have been opened for the mining of soft ore, while a new hoist house and engine will be put in at once at No. 3. The foundation for the engine has already been finished. The new slope is ready for mining and this place will employ an increased number of men. The mines of the company have run steadily all winter and there is no prospect of any closing down.

Trade Catalogs

Receipt is acknowledged of the following trade catalogs and circulars:

Fort Wayne Electric Works, Fort Wayne, Ind. Bulletin No. 1104. Multiphase Belted Alternators—Form B. Bulletin No. 1105. Fort Wayne Electric Fan Motors. Pp. 8, illustrated, paper, 8x10½ in.; February and March, 1908.

H. W. Johns-Manville Company, 100 William street, New York. Asbestos Fire-Resisting Cements. Asbestos Papers, Roll Board, Sheet Board, Building Felts, Etc., Insulated Arc Lamp Hanger, Asbestos Lead Joint Runner. Folders and Leaflets. Illustrated, paper, 3½x6 in.

Sprague Electric Company, 527-531 West 34th Street, New York City. No. 226. Instruction Book on Round Type Motors and Generators. Pp. 32, November, 1907. Circular 428. Stamped Steel Outlet Boxes and Fittings. Pp. 8, July, 1907. All illustrated, paper, 3½x6 in.

Construction News

Bates, Arkansas—The Harper Coal and Coke Company is preparing to make additions to its coal-mining plant. George Harper, Fort Smith, Ark., is president.

Central City, Colorado—The Hearne Gold and Copper Mining Company, with H. W. Kane as manager, is arranging for the installation of an electric hoist and compressor.

Tulsa, Oklahoma—The Tulsa Portland Cement Company proposes to put up a plant for making portland cement, and will need machinery. J. G. McCannon, Tulsa, Okla., is at the head of the project.

Eldora, Colorado—John H. Kemp, Boulder, Colo., has interested Eastern capital in the purchase of the Bailey mill and it is to be remodeled into a modern cyaniding plant with an initial capacity of 100 tons per day.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at Salt Lake City, San Francisco, Toronto and London

REVIEWS OF IMPORTANT EVENTS

San Francisco

March 18—The register and receiver of the United States Land Office at Susanville, Lassen county, have handed down a decision adverse to the North California Mining Company, consisting of H. H. Yard and associates, holding that in the matter of some 90 mineral claims there was no evidence of mineral. This decision will now be forwarded to the Land Office at Washington, D. C., for approval. It does not affect all the Yard holdings, as the contest in other cases is pending at the land office at Sacramento. The lands affected are in both Butte and Plumas counties, largely on the North Fork of the Feather river, and comprise in all some 235,000 acres. If this decision is confirmed by the Land Office and Secretary of the Interior, these lands located as mining claims will revert to the Government as timber lands. Mr. Yard and his associates obtained by location and purchase between 800 and 900 placer-mining claims in Butte and Plumas counties. Many of these claims had been worked in early days and abandoned, leaving them open to location, while others were still being mined, and others again had never been worked. Annual assessment work has been performed upon them regularly in due conformance with the mining statutes. It has been the contention of the opponents of Mr. Yard that the claims were merely located to secure the timber and were not actual mining claims under the law. This decision affirms this contention. Moreover it is found that the legal amount of assessment work has not been done upon them, in the proper manner, much money having been spent on roads, telephone lines, etc. The decision states that against a valuation of timber of $320,000 on the claims only a nominal amount of gold could be shown. The testimony has all been forwarded to Washington. The matter is one which affects many persons not only in the two counties named, but elsewhere in this State. They have taken up mining claims, but where there is also timber, and they are having difficulty in getting patents to these lands. It may be stated that these proceedings in the Yard matter were inaugurated by State Mineralogist Lewis E. Aubury.

The Champion Mining Company, of Nevada City, the largest company at that place, and the one owning the most ground, is about to sink a new deep shaft in virgin ground. The shaft will be sunk from the 800-ft. level below what is now known as the Wyoming shaft. In the various properties owned by the company there are five hoists in operation, but now that the properties are under one ownership, it will be more economical to concentrate this work. The new shaft will be as nearly central to the ground where the best values have been obtained, as possible.

Arrangements have been made whereby the Mammoth Copper Mining Company at Kennett, Shasta county, will refine the copper matte of the De La Mar smelter into blister copper at its local plant. It was supposed that owing to the closing down of certain smelters in the Salt Lake valley, some Utah ores could be shipped to Kennett to be treated in the United States Company's smelter there, but it has been decided to put a new smelting plant at Ely, Nevada, and send the Utah copper ores there for reduction.

The dredge which is excavating for an artificial lake at South Side Park, Sacramento, is turning up some gold in the sands and a system for saving this gold has been put in use. Instead, however, of taking the usual methods someone has devised an "electrolytic sluice box" with copper plates, quicksilver, electricity, etc., and put it into use. There is gold in this sand, but it remains to be seen whether or not it can be profitably saved.

The Penn Chemical Company, of Campo Seco, Calaveras county, is actively producing copper on a large scale, with some gold and silver. The plant has been gradually enlarged and the smelter is kept continuously at work. About 12 eight-horse teams are busy daily, between that point and Valley Spring, on the railroad, hauling material to and from the smelter, making a round trip daily.

Salt Lake City

March 20—Mining conditions seem to be improving in this State. In the Tintic district, a new smeltery is being built and its owners say it will be ready for commission some time in May. The new smeltery in the Tintic district, which will treat custom ores, will be of material benefit to the mine owners of Eureka, Mammoth, Silver City and surrounding camps, as well as to those of some of the districts in southern Utah and Nevada. This smeltery is to be much more pretentious than was originally planned. Instead of two lead furnaces with capacity for the treatment of 400 tons of ore per day, the initial unit is to consist of four furnaces, thus giving capacity for the treatment of 800 tons per day. In addition to the lead furnaces, furnaces for making copper matte will be added; the Minneapolis Steel and Machinery Company has been awarded the contract for the 44x120-ft. steel building which is to cover this addition of the plant. It will be constructed with the view of immediate enlargement. It is expected that the copper furnaces will be ready for service some time in July or not later than August 1. The Tintic Smelting Company is financed by some of the wealthiest mining men in Utah, and there is no doubt that it will take considerable business away from the American Smelting and Refining Company and other competitors. The Murray smelter of the American Smelting and Refining Company has been running on low tonnage for some time, and the company has begun to wonder regarding its supply of lead ores from Utah camps.

Several mines in the Tintic district, which were closed about the first of the year are about to resume. Several properties will be started up April 1.

The Columbus Consolidated Mining Company has an indebtedness of about $18,000; it is probable that shareholders will be assessed to meet the obligation and to provide means to carry out proposed development. The shipment of ore ceased about the first of the year. In the meantime, the management has been doing much development work.

Dividends have been ordered paid by the directors of several mining companies this month. The Mammoth company has declared a dividend of $20,000; Bullion Beck & Champion, $60,000; and Utah, $3000.

Local shareholders of the Newhouse Mines and Smelter Corporation, representing 44,700 shares, have held a meeting and will request representation on the board of directors at the annual meeting of shareholders in New York, which is to be held on March 27.

The Weimer Copper Company, which has operated a property in Lemhi county, Idaho, during the past year, but whose head office is in Salt Lake, is in financial distress. At a special shareholders' meeting, held March 16, it was discovered that the corporation did not hold a clear title to its properties, and that it practically had no assets.

Reports received from southern Utah indicate that interest in the Virgin City oil district continues. A number of companies and individuals are actively drilling

for oil and gas; so far, with encouraging results. Considerable confidence is expressed that the field will develop into one of importance.

Butte

March 25—The Washoe smelter is receiving about 8000 tons of ore per day from the Amalgamated, North Butte and Butte Coalition mines in Butte, and the capacity of the smelter, 10,000 tons per day, will probably be reached in about two weeks. The new policy of the companies to produce copper as cheaply as possible without attempting to make a record production is already showing results. The superintendents' reports indicate that more ore is being hoisted per man than at any time during the last seven years.

Butte Coalition has three levels of first-class ore in the Rarus mine, and that property during the last six months has developed rapidly; at present it is shipping nearly 1000 tons of ore daily. In a few weeks mining will be resumed in the Minnie Healy, which will be able to yield at least 1000 tons more. With the Coalition interest in the ore being mined from the Red-Penn by the Boston and Montana and the mining that will be done in the Tramway and Snohomish jointly by the Coalition and Butte and Boston, the Coalition output will reach approximately 3000 tons of ore per day in a short time. The North Butte is shipping about 1100 tons daily, although the company's contract with the Washoe smelter permits it to ship 2000 tons per day.

Some reports circulated about East Butte, which the officers say were malicious, caused a raid on its stock last week. It was reported in Boston that the Amalgamated Copper Company was about to bring an action against the East Butte claiming all of the latter's orebodies. John D. Ryan, managing director of the Amalgamated, is authority for denial of the report, which was enlarged from the fact that some lessees working in the East Butte ground got across the boundary lines of the East Butte and mined some ore out of Amalgamated ground.

The affairs of the British-Butte Mining Company have been satisfactorily adjusted and the statement made by President E. H. DeHora that suit would likely be brought against the former management of the company has been repudiated by the officers of the C. W. Syndicate, of London, financial backers of the British-Butte and its principal stockholder.

Toronto

March 18—On March 18, Hon. Frank Cochrane, Minister of Lands and Mines, introduced in the Ontario Legislature a government bill to consolidate and amend the Mines Act. The changes made are mostly in the way of simplification and re-arrangement. The most important alteration in the law is the abolition of the closed season between Nov. 15 and April 15, during which, at present, no work is required to be done on locations. As a great many discoveries are stated to have been made, on the strength of which claims have been recorded in the winter time, the Government is of the opinion that if discovery work can be done in the winter prospectors should also be able to work their claims. The change is intended to prevent staking "snowshoe" claims, frequently of a fraudulent character. The forfeiture clause has also been modified and claim holders are given three months, in place of 30 days to have forfeitures repealed.

D. D. Mann, vice-president of the Canadian Northern Railway, which is largely interested in the Moose mountain iron mines, north of Sudbury, announces that the mines will be ready to ship ore on the opening of navigation, by which time the railroad and the docks at Key Harbor, on the Georgian bay, will be completed.

A reorganization of the Montreal Smelting and Reduction Company has taken place and a new board has been appointed comprising J. E. E. Leonard, president; J. H. Brown, vice-president; B. Burland, treasurer; Rodolphe Forget; Louis Payette; W. H. Turpin; and Pierre Tetreault. It is announced that the operation of the smelter at Trout Lake will begin at once.

London

March 17—There is very little business at present in the shares of South African mines, although the returns from the leading producers are of a satisfactory nature. The public objects to the amalgamation schemes, now so common, which are in some cases a round-about way of writing down capital. A deep-level mine that cannot raise the funds to bring it to the producing stage is amalgamated with a neighbor that is dividend-earning, the excuse given being that of longer life and a saving in administrative expenses. The control of the mines is in the hands of financial groups or houses and the small shareholder has practically no say in the management of his property. The mining houses, having interests in the adjacent mines, or blocks of ground which may be proposed for amalgamation, will regard the views in a different light from the individual shareholder in the paying mine. The mining houses, no doubt, try to deal fairly with all interests, but the system is a bad one, where the people selling are also those who decide the price. To guard against abuse of this power independent valuation of the interests to be amalgamated has been proposed. Another scheme for safeguarding the interests of the shareholder that has been advocated lately is the formation of a shareholders' association which would appoint officials to investigate amalgamation schemes and generally help watch over the interests of the small shareholder who is not resident in South Africa.

The Exploration Company has had a bad year. The investments of the company in South African securities and in copper mines in the United States have been unfortunate, and a loss under these headings of £158,418 was reported. R. T. Bayliss, the chairman, explained that the investment of the company's funds in copper shares had only been made after careful consultation with persons largely interested in the copper industry, who were capable of taking a long view of the position. He considered that the depression in the copper industry was abnormal and that a recovery to normal conditions would soon take place. As regards Kafirs, Mr. Bayliss admitted that his judgment had been at fault in common with many other people. The company is also interested in El Oro mine and the Tomboy, both of which mines are giving satisfactory returns.

The Directors of the British South Africa Company are asking the shareholders to contribute to an immediate issue of £1,000,000, the subscribers being given options to subscribe a further £2,000,000 at a later date. The money is required to provide for obligations, such as the guaranteed interest on railway bonds, and for the development of their vast estate, which covers, it is said, an area as large as western Europe. The company was incorporated on Oct. 29, 1889, and has now an issued capital of £6,000,000. No dividend has yet been paid, the expenditure having always exceeded the revenue. For the year ended March 31, 1907, the balance of expenditure in excess of revenue amounted to £105,211. Payments made for railway debenture interest under guarantee are not included in the above account, but appear in the balance sheet as loans to the railway companies. The £1 shares of the company are quoted at the present time at about 14s., or considerably below par, and in order to attract subscribers for the new shares at par—the issue of shares at a discount being illegal—the novel plan of offering options for additional shares up to 1910 and 1912 has been adopted. Whether the shareholders will come forward remains to be seen. But the patience of the chartered company's shareholders is something phenomenal, and it would not be surprising if further funds were given. Possibly it is patriotism and not mere sordid money-making that induces many to subscribe to this great enterprise. Anyhow, in spite of many disappointments, additional capital has from time to time been raised when asked for, and there may be stockholders who still share the confidence and enthusiasm of the directors and who believe that the commercial success of the company is not far distant.

Mining News from All Parts of the World

New Enterprises, Installations of New Machinery, Development of Mines and Transfers of Property Reported by Special Correspondents

THE CURRENT HISTORY OF MINING

Arizona

YAVAPAI COUNTY

Jerome Mines Development Company—This company, operating at Jerome, has completed the installation of a hoisting plant, capable of hoisting from a depth of 1000 ft. Sinking will be continued to the 700-ft. level. The ground belonging to this company has been thoroughly prospected by diamond drills.

Black Warrior—This property near Middleton, is being operated by local men. At a depth of about 40 ft. a body of shipping ore was encountered. The management announces that one car per week will be shipped from now on.

Cardinal Mining Company—This company, operating near Poland, has ceased milling until amalgamating plates can be installed in the mill. The ore being milled contains a large amount of free gold which is not recovered by the concentrators.

Penn-Arizona Mining Company—This company is making rapid progress with development. Ore shipments will be commenced as soon as the Humboldt smelter resumes operations.

Poland Mining Company—This company, operating at Poland, shipped three bars of bullion valued at $6000, as a result of the cleanup for the first half of March. Besides the bullion a large amount of concentrates are being made.

Water Power—John Lawler and Homer Wood, of Prescott, have been having extensive surveys made in the vicinity of Thompson valley, the purpose of which is the location of a storage reservoir for power purposes. The proposed plant will furnish about 15,000 horse-power.

California

AMADOR COUNTY

Santifiro—At this claim, Volcano, Griesbach & Co. have struck the pay ground. The property yielded well in early days, but has been idle a long time.

BUTTE COUNTY

Gardella—S. & J. Gardella, who have a dredge at Oroville, are to build another on the Kentucky ranch 14 miles southeast of Oroville. The gravel is about 15 ft. deep.

CALAVERAS COUNTY

Melones Mining Company—This extensive property, Frank Langford, superintendent, which has been closed down for two months owing to a walk-out of the miners, will resume operations on the following basis: The hours underground will be: Leave shaft collar or tunnel mouth at 7 o'clock; 30 minutes for lunch; quit work on the respective levels at 4.30. At surface and mill: Begin work at 7 o'clock; 30 minutes for lunch; quit work at 5 o'clock, excepting machine tenders, who will have one hour for lunch alternately and work 11 hours.

Nelson Contracting Company—This company, which up to a year ago operated its mine at Calaveritas by hydraulic process, has sold out to E. T. Magoffin. The gravel was too much cemented to be hydraulicked, so will now be crushed in a mill.

EL DORADO COUNTY

Manhattan-California Mining Company—This company at Nashville, F. W. Hyatt, superintendent, is operating the old Mountain Boy mine and several prospecting shafts have been sunk. Twenty men are at work shaft sinking.

NEVADA COUNTY

Ancho—This property at Graniteville, at an elevation of 5000 ft., has been closed down until warm weather will permit operations being carried on.

Fairview—In this mine the vein is showing up well and the company intends to erect a 20-stamp mill in the spring.

Niagara Mining Company—The shaft of this mine, now down 400 ft., is in a good ledge, and the mill is kept running most of the time.

PLACER COUNTY

Bellevue Mining Company—The new company of Reno, Nev., men who have bonded this mine at Ophir has the following officers: Richard Kirman, president; W. J. Harris, vice-president; Fred Grub, treasurer; R. J. Trimble, manager.

PLUMAS COUNTY

Arcadia—In this property at Greenville, the recent rich strike was in a blind lead met in a tunnel being run to the Savage ledge. The ore is high-grade for that section of the State.

SAN BERNARDINO COUNTY

Kessler Spring—The miners of this locality, near Cima, are about to organize a mining district. Fifteen properties are in operation there, two of which, the King Thebaw and Arcalvada, are shipping ore to Salt Lake. The former of these two properties is to be incorporated.

SIERRA COUNTY

Morgan Mining Company—The Young America gravel mine at Forest City has been transferred to this company, of which J. W. Morrell, J. L. Green and W. Morrison are the principal owners. There is good gravel in the drifts ready for washing.

SISKIYOU COUNTY

California Consolidated Company—This company, W. H. Young, manager, which is operating the old Gold Ball mine at Rollin, has just had a successful run.

Race Track—At this property a second shaft is being sunk, and it is expected that pay gravel will be reached at 120 ft. The gravel found in the first shaft is like that of the Blue Gravel mine.

TRINITY COUNTY

Joseph McGillvray has bonded the Murphy, Laws and North Mountain gravel mines at Junction City, and will place J. W. Shuford in charge. These hydraulic mines have been worked more or less, but combined in one system, with good water rights, better success can be made with them now.

TUOLUMNE COUNTY

Porto Fino—Electric power is being installed at this mine, Jos. White, superintendent.

Colorado

BOULDER COUNTY

Little Silverite Group—Maxwell L. Roder, of New York, representing Eastern capital, has bonded this group in the Sugar Loaf district for $30,000; William Breucker, of Boulder, was the owner.

General Lee Group—This group of claims on Spencer mountain in Grand Island district has been purchased by the Pennsylvania Gold and Silver Mining and Milling Company.

Ragged Top—Denver and Chicago people have purchased this group; J. M. Pine, of Sugar Loaf, has been appointed manager.

CLEAR CREEK COUNTY

Charter-Raton Group—Operations have been resumed; J. J. Bonner, of Empire, is manager.

Waldorf Consolidated Mining Company—In a stope of the Wheeling vein in the Tobin adit some high-grade silver ore has been developed.

Sun and Moon Group—Operations have been resumed on this property under the management of R. C. Bonney, of Idaho Springs. The Sol Luna Mining Company, in which Philadelphia capitalists are interested, has taken a long-term lease and option on the property, and will work the property both from the shaft and from the Newhouse tunnel.

GILPIN COUNTY

Smart Group—This group in the Independent district, including three lode claims, Perigo mill site and the Rollins 10-stamp mill, has been sold to John Chase, of Denver. Arrangements are being made for resuming work at the property.

Creede-Gilpin Mining Company—Colorado and Eastern people are interested. Machinery is being installed on the Fannie group near Black Hawk. O. A. Songer, of Black Hawk, is manager.

East Notaway Group—This property in the Russell district has been sold by the Town Topics Gold Mining Company to the United States Exploration Company. Tom Martin, of Central City, is superintendent.

Bonanza—This property in Chase gulch is being started up by Theodore H. Becker, of New York. Work will be carried on through the shaft and adits. Henry Becker, of Central City, is manager.

Queen of the West and *Robert Emmett*—These properties have been started up by B. Barnard and associates under a lease and option; B. Barnard, of Central City, is manager. The properties are being unwatered.

Lulu—This property in Boulder Park, operated by C. Barth, of Denver, is to be equipped with steam machinery. C. Ward is superintendent.

Pewabic Gold Mines Company—John C. Fleschhutz, of Central City, who is manager, is placing an order for two 100-h.p. high-pressure boilers for the Pewabic mine. A steam hoist has been installed at the Richardson shaft for leasers, who are mining considerable smelting and milling ore.

Good Gold and Silver Mining Company—This company has acquired the Belvidere property in Fairfield district. The mine will be developed by an adit. H. R. McClelland, of Denver, is manager.

War Dance—A streak of high-grade ore has been found at a depth of 140 ft. The ore carries gold, silver and copper.

JEFFERSON COUNTY

Golden Smeltery—It is reported that arrangements are being made to start up this smelter, which was formerly run on low-grade ore from Gilpin and Clear Creek counties. The Saratoga Development Company, in which Eastern people are interested, is arranging to treat at this smelter the low-grade smelting ores from the Saratoga property; they will in all probabilities handle custom ore as soon as they are in shape for active running of the smelter.

OURAY COUNTY

Camp Bird—During the quarter ended Feb. 1, 20,776 tons of dry ore were crushed; receipts from the sale of bullion amounted to $395,911; from the sale of concentrates, $72,066; working expenses, including development, transportation and treatment of product, were $175,374. Construction work cost $3330; London expenses were £900. Profit for the quarter amounted to £59,960. At the mine, 1299 ft. of drifting was done; 429 ft. of advance in raises and winzes was made; 135,287 cu.ft. of stoping was done. During the quarter, 56 per cent. of the ore was withdrawn from reserves in the stopes. On Jan. 31, the total tonnage of dry ore broken in the stopes amounted to 89,188 tons.

Florida

POLK CONTY

Florida Mining Company—This company's plant, which has been under construction near Mulberry, is practically completed and is ready for operation. It will have an annual capacity of about 80,000 tons of phosphate. Officers of the company are Charles E. Hudson, president; Harry L. Pierce, vice-president; Frederick W. Howden, general manager, and Edward P. Hadley, secretary and treasurer.

Idaho

SHOSHONE COUNTY

West Hecla Mining Company—Development work has been resumed after eight weeks of idleness. This company's property lies between the Tiger and Standard mines of the Federal Smelting and Refining Company, and is supposed to carry the Tiger vein. An adit 750 ft. long has been run and a contract for 300 ft. more has been let.

Black Bear Fraction—Work on this property, near Burke, which has been shut down for four weeks has again been resumed and an adit will be driven at the 1400-ft. level to strike the vein. Extensive development work has been done on this property during the past winter, and it is considered one of the best prospects in this section.

Indiana

GREENE COUNTY

Indications are that the great Howesville coalfield will not be developed as soon as anticipated. Several months ago Chicago capitalists obtained options on 10,000 acres of coal lands, in this county, agreeing to pay $40 an acre. A few weeks later they ordered the abstracts prepared, and when, on March 14, they called for their deeds they asked the farmers to accept $5 per acre cash and $35 in stock. The proposition was rejected by the farmers and the options will expire in a short time.

VIGO COUNTY

Coal in large quantities is being stored by most of the railroads and dealers who have contracts to fill. It is said the railroads have become thoroughly aroused and most of them are ready for a suspension if it comes.

Iowa

ZINC-LEAD DISTRICT

Dubuque—The Avenue Top mine is the only mine that is shipping regularly, and it is producing a car a week that will assay 45 to 50 per cent. zinc.

Kentucky

BELL COUNTY

Highland Run Coal Mining Company—This company, at Four Mile, 12 miles south of Barboursville, has completed a new opening and has just completed the erection of one of the largest tipples in eastern Kentucky. With the additional mine the company, already one of the largest producers in Bell county, will be in shape to get out a larger production.

Hughes-Jones Coal Company—This new company has leased the big operation of the Greasy Creek Mineral Company on the Knox county border. The lease consists of 900 acres of territory and a mining plant which was installed last year. The new company will take charge at once.

Straight Creek Colliery Company—This new company has its office at Barboursville. The officers are D. W. Williams, president; J. W. Williams, vice-president, and L. W. Farmer, general manager. The company has secured a lease of 260 acres in the Straight Creek district and will install a mining plant at once. There are two seams of workable coal on the property, 40 in. and 4 ft. in thickness, respectively.

KNOX COUNTY

Lynn Camp Coal Company—This company has completed installation of additional machinery at its mines at Grays in connection with its development of 600 acres of land; present capacity 300 to 400 tons monthly, and output will be increased to 500 tons. About $60,000 has been expended for equipment and about $5000 will be expended for houses and other improvements. The company's recent machinery installation included 125-h.p. boiler and pumps, air compressor,

mining machines, etc.; A. Berhalter, of Danville, Ill., is president; A. B. Palmer, Grays, Ky., general manager.

The Gibson & Carr and the Anchor Coal companies are making openings in the Tye Fork section. A railroad siding about two miles in length is being extended from the Cumberland railroad to tap the property. These companies are composed of Knoxville, Tenn., operators.

Maryland

ALLEGHENY COUNTY

Consolidation Coal Company—This company, the largest operator in the Cumberland region, reports for 1907 gross earnings of $4,443,804; expenses were $2,899,774 leaving net earnings, $1,744,030. Other income brought the total net to $2,118,225. All charges and dividends were $1,466,816, leaving a surplus of $651,409. The coal statement is as follows:

	1906.	1907.	Changes.
Mined by company...	2,128,879	2,092,016	D. 36,863
Mined by tenants.....	368,292	420,463	I. 52,171
Total...	2,497,171	2,512,479	I. 15,308

The total in 1907 was 58.3 per cent. of all shipments from the Cumberland region.

GARRETT COUNTY

Western Maryland Coal Company—This company is arranging to install mining plant, and expects to begin in the spring development of 750 acres of coal land near Westernport. J. K. Wimbrough, New York, is president; M. P. Gannon, of Westernport, secretary and treasurer.

Missouri

ZINC-LEAD DISTRICT

A novel suit has been brought by a Carthage company against two drill-men. The defendants made a report that the drill showed 11 ft. of ore; on the strength of this the company sunk a shaft, but found no ore. Now it sues for $4000 damages.

American Zinc, Lead and Smelting Company—It is generally reported that this company will not reopen its mines before August.

Genesee—This company, at Webb City, has just connected its two shafts by an air drift, and will start its plant at once. The company has a 10-acre lease on sheet ground, showing a 10-ft. face of ore. The mine has two shafts, ore-bins and a 250-ton mill.

Lichliter & Co.—This concern has its shaft down to ore, and a tramway completed to the mill. Production will soon be begun from the lease, which is near the Marion B., in South Joplin.

Myers—On the strength of the rich strike of L. P. Benna made here recently, Aaron Myers has sold his 200x200-ft. lot for $9000 to J. M. Koewler, of Ripley, Ohio.

Old Apple Tree—This mine, at Cave Springs, has made its first turn. It has a 76-ft. face of lead and zinc ore disseminated in limestone—an unusual occurrence in this locality.

Montana

BUTTE DISTRICT

East Butte—Several sets of lessees are working in the property and are again shipping ore to the Washoe smelter. It is stated that a deal is on for the erection of a large concentrator by the company and probably an independent smelter in Butte, in which the East Butte will have a large interest.

Amalgamated—The Washoe smelter began to turn out copper on March 18, and will probably add 6,000,000 lb. to the Butte district's output this month, making the total between 14,000,000 and 15,000,000 pounds.

Anaconda—The only development work that is being done is on the 2400 and 2200 levels, where the big veins are being opened by drifts and raises.

Butte Consolidated Copper—A shaft 200 ft. deep has been sunk on the Susie claim and water and sulphides have been encountered. The water is so strong that the miners were drowned out and work had to be suspended temporarily. The property of the company lies a little north of the Butte & Bacorn mines and the company is the first to strike water in large quantity. This is a hopeful indication.

North Butte—No work is being done in developing the Berlin group of claims, all work being confined for the present to mining in the Edith May and Jessie mines. Just before the shut-down the company cut the Berlin vein on the 1600 level.

FERGUS COUNTY

Barnes-King Development Company—For the first time since this company has had control of the Barnes-King mine it paid expenses of operation in February. The development work is still going on and Supt. McGee reports that the property is improving.

Nevada

ESMERALDA COUNTY—GOLDFIELD

Goldfield Consolidated—Four cars, the first shipment for several months, were shipped from the Mohawk mine last week. This shipment was necessary because the ore bins were full of ore; most of this ore comes from the winze being sunk from the 450-ft. level. This winze is 130-ft. deep. At a depth of 150 ft. in the winze or on the 600-ft. level of the mine a station will be cut and a crosscut driven to the ore shoot. The grading for the Consolidated mill is completed and the tracks leading to the different shafts are almost finished. It is reported that the Mushett lease on the Miss Jessie claim of the Laguna group has found ore in the shaft at a depth of 418 ft. The shaft is being sunk with three shifts; machine drills are used. Several leasers are prospecting for ore on the Laguna group.

Little Florence Lease—This lease on the Florence is working 100 miners. Frank Oliver is manager. It is reported that the Little Florence has developed the extension of the Florence Annex orebody in its block of ground.

Florence—At the mill the machinery is being installed as fast as it arrives. The cyanide tanks have been completed. The headframe, the second largest in the camp, has been finished.

Daisy—The Truett shaft is being unwatered; two Cameron pumps and the plunger pump, formerly on the 350-ft. level of the Mohawk, are used. About 30 men are working at the No. 1, or Bjorne, shaft. This shaft is only 210-ft. deep.

NYE COUNTY—BULLFROG

Montgomery-Shoshone—It is reported that a good body of ore has been found on the 600-ft. level; the ore is said to be 4 ft. wide.

Amethyst—The shaft is almost 400 ft. deep; as soon as that depth is reached, crosscuts will be driven.

Gold Bullfrog—The development work at this property amounts to more than 2000 ft. The No. 1 adit, driven at a depth of 137 ft. below the outcrop, is 345 ft. deep; No. 2 adit, driven at a depth of 239 ft. below the outcrop, is 723 ft. long. Crosscuts have been driven from these drifts. An incline shaft is being sunk to develop the mine at greater depth. The mine is equipped with a 50-ton mill.

NYE COUNTY—TONOPAH

The ore shipments from the Tonopah mines for the week ending March 12, as reported by the Western Ore Purchasing Company, consisted of 103 tons from the MacNamara. The Tonopah company sent 3210 tons, the Belmont company 500, the Montana-Tonopah 1100, the Jim Butler 500, and the Midway 180 tons to the mills, making the total shipments for the week 5613 tons.

Tonopah—The electric hoist at the Mizpah shaft is being re-wound so that the hoist can be run with electric power from the Nevada-California Power Company's line. As soon as this is finished the hoist at the Silver Top shaft will be re-wound. Some repairs are being made to the surface plant. The usual development work is being done on the levels above the 600-ft. The crosscut on the 900-ft. level, west of the shaft, has cut the footwall of the vein.

Belmont—During last week 264 ft. of development work was done on the 700-ft., 800-ft., 900-ft. and 1000-ft. levels.

Tonopah Extension—The usual amount of development work is being done on the

270-ft., the 400-ft. and 500-ft. levels and some ore is being mined.

North Star—It is reported that ore has been found in the drift following the fault fissure on the 1250-ft. level. A winze has been sunk on the ore. The vein is said to be 7 ft. wide and to have an east and west strike; the ore is sulphide.

STOREY COUNTY

Ophir—From the 2100-ft. level, 146 cars of ore were mined; from the 2200-ft. level, 166 cars; 310 cars of second-class ore were sent to the Kinkead mill.

Ward Shaft—The suction fan is now running and the temperature at the 2475-ft. level has been lowered considerably.

Yellow Jacket—During the week 1158 tons of ore were mined and milled; 79,000 lb. of concentrates were shipped to the Selby smelter.

Crown Point—From the 1400-ft. level 29 tons of ore were mined.

WHITE PINE COUNTY

Nevada Consolidated—It is said that 95 per cent. of the bond issue was taken by the stockholders. It is expected that the first section of the Steptoe mill will go into operation early in April, and the smeltery during May. The railway to the works is completed. The ore will be brought down from the mines in trains of 22 cars holding 50 tons each.

Oklahoma

CREEK COUNTY

Tulsa Portland Cement Company—This new company is preparing to put up a portland cement plant at Tulsa, where there are abundant supplies of raw material. It is to have a capacity of 2000 bbl. daily. The directors are J. G. McCannon, Robert Galbreath, J. O. Mitchell, Frank Chesley, J. E. Sater and George W. Adams.

Pennsylvania

BITUMINOUS COAL

Dilworth Coal Company—According to the Connellsville *Courier*, this company, operating a mine at Rice's Landing, near Washington, has secured a temporary injunction against the Ten Mile Gas Company of Waynesburg, restraining the latter from continuing the drilling of a gas well through the coal vein operated by the Dilworth company. The Ten Mile company recently drilled to a depth of 800 ft., the hole being bored through an abandoned portion of the Dilworth mine. Mine inspectors when they discovered the situation ordered the coal company to proceed against the gas company. The inspectors claim that should pressure of gas be obtained it would escape into the open abandoned workings of the mine, fill the chambers and imperil the lives of the workmen.

Somerset Coal Company—This company's statement for 1907 shows gross earnings, $2,368,865; working expenses, $1,878,793; net earnings, $490,072. Other income was $150,066, making a total of $640,138. Interest, sinking fund, etc., amounted to $323,725, leaving a surplus of $316,413 for the year.

COKE

Northern Connellsville Coke Company—The directors have elected Daniel Hunt, of Uniontown, president, to succeed Wade H. Echard, who has sold out his interest in the company. James H. Doyle succeeds Mr. Hunt as vice-president.

Port Royal—Pneumatic water lifts are being put in at this old mine, for the purpose of unwatering it. It is not known whether it will be worked again, but in its present condition, full of water, it is a menace to neighboring operations.

South Dakota

CUSTER COUNTY

Ivanhoe—The 50-ton cyanide mill will shortly be operated. A new strike was just made of good ore found in an 18-in. vein that is now being opened. The orebodies have been systematically developed for four years.

LAWRENCE COUNTY

Cleopatra—Some time this coming summer it is expected to operate the mill as the development work is opening up good ore.

Snowstorm—The Mogul company has given up its lease on this property and it will be operated, together with the Halcie and Emory ground, by John Hawgood, the owner. The work will commence at the level of the Ben Hur tunnel and at a depth of 350 ft. The Snowstorm mill is being repaired.

Terry Peak—The three larger companies in this section are uncovering greater quantities of smelting ore and the Imperial has just shipped some to Denver.

Wasp No. 2—Cost of operation has been reduced by the installation of air drills in the mine operated on the face of the open cut. The mill continues to handle 200 tons daily of ore that averages about $2 per ton.

PENNINGTON COUNTY

Crum—A strike of ore carrying copper, silver and zinc has been made in a shaft 16 ft. deep. The property lies between Mystic and Redfern.

Dakota-Calumet—Electric machinery is being installed and when completed the tunnel to connect the shaft and smelter will be finished. The shaft is 500 ft. down.

Teddy Bear—The main tunnel is in over 100 ft. and is now in mineralized material.

Tennessee

BLOUNT COUNTY

LaFollette Coal, Iron and Railway Company—This company has leased 20,000 acres of iron-ore land. Of this land 19,000 acres is located about 12 miles east of Marysville and the other 1000 acres about seven miles south of Marysville. The company has been doing some extensive prospecting on the new acquisition and plans important railway construction to tap the ore lands.

Utah

JUAB COUNTY

May Day—Mining will be resumed April 1.

Centennial Eureka—All the output of this mine, except 50 tons per day, which goes to the Yampa smelter in Bingham cañon, is still being forwarded to the Mammoth smelter at Kennet, California.

Black Jack—The management has let a contract to run an adit to connect with the loading station on the tracks of the Eureka Hill railway.

Washington

FERRY COUNTY

Black Tail Group—J. E. McFarland has just completed a working-bond arrangement with the owners of this group near Republic, and will soon put a crew of men to work getting the mine in shape for mining. This group of four claims lies contiguous to the Lone-Pine group, which the Syndicate Deep is now working. The Black Tail property shut down several years ago at the time that most of the other mines at Republic shut down. Before this, however, it had shipped to the Granby smelter 377 tons of gold ore, that averaged more than $18 per ton. Another lot of 286 tons was treated at the cyanide plant of the old Republic mill, but owing to that mill's bad adaptation to the ores in hand, only $14 per ton was saved.

Syndicate Deep—After several weeks spent in pumping and cleaning out the old levels, a second shipment or ore is being made from the mines belonging to this company.

OKANAGON COUNTY

Grant Consolidated Mining Company—This company, which has held a bond on a number of claims near Chesaw, Washington, owned by British Columbia people, has made payment on the bond, and has taken the property. The company has been developing this property for some time, and has expended $90,000 upon it. During the spring some large bodies of sulphide ore carrying copper have been developed.

STEVENS COUNTY

Oriole Mining Company—This company in the Metaline district is preparing to extend its crosscut adit to prospect for a lead-silver vein lying several hundred feet beyond the present face. The drifts, driven each way from the 300-ft. station in the adit, are in ore, some of the recently opened ore being rich in brittle silver. The ore shoot is said to be five feet wide; a richer ore streak, one foot wide, follows the footwall, the remainder is a concentrating ore carrying mainly galena.

Chewelah Copper Mining and Smelting Company—This company, which owns six claims near the town of Chewelah, is, at present, seriously handicapped by water, but a new hoist, engine and pumps are to be ordered soon so as to develop the vein at greater depth.

United Copper Company—This company is working steadily, shipping 200 tons per month to the Northport smelter. This company, which was behind a movement to build a smelter in this district, has now decided to abandon the project temporarily, on account of the favorable rates being paid by the smelter. A winze, 45 ft. deep, has been sunk from the 400-ft level; it is planned to sink this winze to a depth of 900 ft.

Germania—A new strike of silver ore has been made in the Seal and Queen mines owned by W. Scheck, representing the Germania company here. This ore was found on the third level; its extent is not yet known. A short time ago another body of similar ore was found, and the ore is now being shipped to the Tacoma smelter.

West Virginia

BARBOUR COUNTY

Pleasant Creek Coal and Coke Company—This company has been organized to develop coal lands. The office is at Philippi, W. Va. E. L. Cunningham and A. G. Newman, of Dawson, W. R. Hurst and H. R. Hurst, of Scottdale, Penn., and G. W. Newcomer, of Connellsville, Penn., are directors.

MARSHALL COUNTY

Edgewood Coal Company—This company has begun to open a coal mine at Edgewood. C. E. Hutchinson and J. L. Phillips, Cameron, W. Va., are incorporators.

Riverside Coal and Coke Company—This company will develop a large tract of coal land, and is making arrangements to begin work. Oliver K. Ward, Moundsville, W. Va., W. G. Smith and Maurice P. Evans, New York, are among the incorporators.

MARION COUNTY

Fairmont Coal Company—This company's statement for 1907 shows gross earnings of $4,860,327. Operating expenses and depreciation were $3,416,299, leaving net earnings, $1,444,028. Other income brought the total up to $2,023,301. Payments, including interest and other charges and dividends of 2 per cent., were $1,381,320, leaving a surplus of $641,981 for the year.

POCAHONTAS COUNTY

Goshen Iron Company—This company, of Goshen, Va., and Wilmington, Del., has purchased and will develop 70,000 acres of iron-ore lands, located between Alvon and Greenbank. It is understood that the company intends to arrange for an early development of the property, about 200,000 tons of the ore to be shipped this year to its furnace in Virginia. The purchase price is reported as $2,000,000. The company was represented in the purchase by A. J. Moxham, of Wilmington.

RALEIGH COUNTY

Chapman-Deegans Coal Company—This company, of Beury, W. Va., has incorporated with a capital stock of $100,000 to develop coal lands in Raleigh county. Incorporators of the company include J. P. Chapman, J. C. Sullivan and K. S. McClanahan, of Beury, and W. E. Deegans and J. B. Hofmeier, of Glen Jean, W. Va.

Wisconsin

ZINC-LEAD DISTRICT

Acme—This company about two months ago adopted the contract system of shoveling and the results attained have proved a revelation to local operators. Twice the amount of dirt is now being taken out with less men and the same number of drills than was formerly done under the flat day wage. Moreover the mill equipment is kept in operation at maximum capacity.

Baxter—This property has reverted to its original four owners after much controversy with Michigan men, who took over a controlling interest and attempted to float the stock on a highly increased capitalization, but failed mainly because of the financial panic. Milling operations were begun this week.

D. D. C.—This company will start erecting a mill just as soon as the frost leaves the ground. The mine shows a good face of jack, both disseminated and sheet formation.

Lyght—This company has decided to erect a 50-ton mill. The mine shows up an 80-ft. ore face, 6 ft. high, rich in solid, irregular sheet formation of zinc ore. On the south side the vein carries one-third lead.

Wcigel—This is a newly equipped property in the Platteville camp that is making a good record; 16 tons of zinc and 3000 lb. lead concentrates were made in an eight-hour run, 75 ton-mill, the ore coming direct from the forehead where it was broken by hand drill. An air compressor, however, will soon be installed.

ZINC-LEAD DISTRICT

Platteville District—This is the most active camp in the Wisconsin zinc district at present, as high-grade ore is being shipped by the Empire, Acme, Hodge, Royal and St. Rose mines. The new electro static separator (Blake-Morseher system) is finished and they are buying low-grade ores.

Benton District—The new mill of the Frontier mine is completed and they are shipping about two cars a week of ore that assays about 45 per cent. zinc. The Etna has started again and is shipping out its large stock of 45 per cent. zinc ore and considerable lead. The Carr mine shipped two cars of lead ore last week that assayed over 80 per cent. lead; the mine has started up and will begin milling next week.

Hazel Green District—The Kennedy mine is the only one that has been operated through the slump, but the Mills, which is the largest producer in the Wisconsin district, is being thoroughly overhauled preparatory to starting up by April 1.

Shullsburg District—While all the Shullsburg mines have been shut down through the slump, preparations are being made to start up again. The Lake Superior people are increasing their holdings in this camp and pushing development work.

Mineral Point—The removal of the zinc and acid works to Depue, Ill., has been postponed, as the threatened litigation has been withdrawn and the Commercial Club has used its influence to retain the most valuable industry of the district. The acid department is running and preparations are being made to start up one block of the oxide furnaces. The Liverpool and John Ross mines are the only active shippers at present.

Linden—The Ross, Dark Horse and Mason mines are running and the Highland mines are resuming.

Canada

ONTARIO—COBALT DISTRICT

Ore Shipments—Shipments of ore for the week ending March 7 were as follows: Coniagas, 61,880 lb.; Kerr Lake (Jacobs), 61,700; La Rose, 90,190; Nipissing, 128,710; Nova Scotia, 40,000; O'Brien, 65,100; Silver Queen, 53,700; Temiskaming & Hudson Bay, 60,000; total, 561,280 pounds.

Kerr Lake Crown Reserve—The new vein is very rich; it is about 25 in. wide, carrying large slabs and nuggets of native silver.

Nipissing—The Kendall shaft is down 123 ft., and has exposed, at that level, from 3 to 5 in. of solid smaltite carrying native silver. Ore available for mining on March 1 is valued at $1,039,000, including $431,000 in the Kendall, $300,000 in vein No. 26, and $158,000 in vein No. 49.

Queen Alexandra—This location, situated opposite the King Edward at Cross lake, has been sold to Toledo, Ohio, capitalists for $50,000. It is understood that the new owners will install a plant and operate the property immediately.

Silver Leaf—Shaft No. 5 is down 96 ft., and at the 75-ft. level 26 ft. of drifting has been done on the vein. The shaft is being timbered and planked. The company has sacked 6 tons of high-grade ore and 10 tons of second-grade, carrying 500 oz. to the ton.

Cobalt Central—At the Big Pete mine on this property a first-class plant is in operation; 80 men and 9 drills are being worked double-shift.

Kerr Lake (Jacobs)—Ninety men and 10 drills are at work. Shaft No. 3 is down 300 ft. Drifting is being done at the 60-, 120- and 180-ft. levels in a southerly direction. Shaft No. 7, on the shore of Kerr lake, is down 160 ft. on a vein more than 12-in. wide and 550 ft. of drifting has been done at three levels.

Little Nipissing—Native silver has been found in the tunnel at about 115 ft. from the surface. On the property leased from the Peterson Lake company the vein has improved at a depth of 20 ft., and has a width of 12 in.

O'Brien—The force at work consists of 120 men and 9 drills, working double-shifts. About 2200 ft. of drifting has been done at the 50-, 100-, 150-, 200- and 300-ft. levels. No. 2 shaft, near the La Rose line, is down 90 ft., and much crosscutting and drifting have been done. Shaft No. 6, sunk between two veins, is down 150 ft.; crosscutting has been begun to cut both veins; one of these veins is a silver-cobalt vein, 6 in. wide. Later in the season the force will be increased to 250 men.

Gillies Limit—The mine owned and operated by the Provincial government on the Gillies Limit, made its first shipment last week, which consisted of 25 tons of high-grade ore to the Deloro smelter.

Lorraine Camp—The rush of prospectors to the new camp south of Lorraine township continues, and the extent of the territory already staked out is about 6 by 3½ miles. A large number of good discoveries are reported. On the Keeley claim a ledge of ore 43 ft. in length is in sight with an average width of 7 in. The assays vary from 3000 to 9000 oz. silver to the ton. About 150 bags of first-class ore have been sacked.

ONTARIO—MONTREAL RIVER DISTRICT

Giffard Locations—A steam plant is being installed and will be in operation in a few days.

ONTARIO—LAKE OF THE WOODS DISTRICT

Violet—The Empire Gold Mining Company, which purchased this gold property last fall, has done considerable development during the winter, and the first cleanup resulted in the production of a gold bar valued at $2000.

NOVA SCOTIA

Dominion Coal Company—On March 8 the coal-washing plant of the company, near Port Morien, was completely destroyed by fire, occasioning a loss estimated at about $100,000.

Mexico

SONORA

Moctezuma Copper Company—This company, at Nacozari, has about completed its 1700-h.p. power plant as well as the first unit of its 2000-ton concentrating plant, and it is expected that they will be placed in commission early in April.

Los Angeles Mines Company—This company, having copper and silver properties near Nacozari, which closed down at the time of the slump in October, is preparing to resume operations.

Creston-Colorado Mining Company—This company, near La Colorado, Sonora, is treating 200 tons of ore a day, and is now making preparations to double the milling capacity. This company paid half a million Mexican currency in dividends during 1907 besides accumulating a surplus of over 400,000 *pesos*.

Belen Mining Company—This company, operating copper and silver properties at Cumpas, has completed its new rotary roaster and 30-ton blast furnace, and expects to blow in and be turning out matte early in April.

Lucky Tiger Combination Gold Mining Company—This Kansas City company has won its suit in the final court of appeals in Mexico, and obtained full control of its properties. Development work is being pushed and a 100-ton mill is in course of erection with rolls, screens, Hartz jigs, 10 vanners and 10 tables, which should be in operation by June or July.

CHIHUAHUA

Chicago-Mexico Consolidated Mining Company—This company is installing the first unit of five stamps on its properties near Cusihuiriachic, and hopes to have the full quota of 20 stamps in before the end of the year.

Mexican Mines Syndicate—It is understood that the creditors of this concern have came to an agreement whereby Ernesto Madero, the largest creditor, will take over La Reina mine and Buenas Aires mill near Cusihuiriachic, and possibly the Minillas mines, near the city of Chihuahua, all part of the syndicate's holdings, and work the properties until the amount due has been recovered, first satisfying some of the smaller creditors.

JALISCO

Mexican Mines-Prospects Development Company, Ltd.—This company has recently obtained control of two important groups of properties, one of which is known as the San Luis del Oro group, situated in Hostopipaquilla and composed of 82 pertenencias; the other is the Juanquiniquila group, composed of 131 pertenencias and about 30 km. southwest of San Marcos. There are several fissure veins in each of the two groups. The San Luis del Oro properties are silver-gold, while the Juanquiniquila are copper-gold; some shipping ore is now being extracted from this latter group. Both the groups, however, are still in the prospect stage, and will be systematically developed and explored. This company was organized about four months ago. The president is J. L. Requena; general manager, P. A. Babb; and on the board of directors are Geo. W. Cook, M. G. Horner and Col. A. G. Mills.

Asia

INDIA—MYSORE

Kolar Goldfield—Gold production in February is reported at 44,191 oz. bullion, being 1675 oz. less than in January, but 967 oz. more than in February, 1907. For the two months ended Feb. 29 the total was 89,234 oz. bullion in 1907, and 90,057 oz. in 1908; an increase of 823 oz. The bullion reported this year was equal to $1,675,324, or 81,051 oz. fine gold.

Europe

SPAIN

Exports of metals from Spain in January are reported by the *Revista Minera* as follows, in metric tons:

	1907.	1908.	Changes.
Pig and manu. iron	11,746	855	D. 10,891
Copper	573	785	I. 212
Copper precipitate	121	1,882	I. 1,761
Lead	12,995	12,056	D. 939
Spelter	13	1	D. 12
Quicksilver	6,089	8,655	I. 2,566

These exports do not include metal contents of ores. Exports of ores and minerals for the month were:

	1907.	1908.	Changes.
Iron ore	883,688	525,572	D. 358,116
Copper ore	85,413	104,498	I. 19,085
Zinc ore	17,979	8,374	D. 9,605
Lead ore	688	214	D. 474
Manganese ore	4,601	4,287	D. 314
Pyrites	93,271	116,896	I. 23,625
Salt	25,811	39,685	I. 13,874

Exports of sulphur were only 2 tons in 1907, and 10 tons this year.

New Caledonia

Exports of minerals from New Caledonia for the year 1907 are reported by the *Bulletin du Commerce*, of Noumea, as follows, in metric tons:

	December.	Year.
Nickel ore	3,879	101,708
Cobalt ore	90	3,943
Copper ore	5	437
Iron ore	....	174
Chrome ore	501	25,372
Magnesite	....	42

December exports included one cargo, 500 tons, of chrome ore, for New York.

Metal, Mineral, Coal and Stock Markets

Current Prices, Market Conditions and Commercial Statistics of the Metals, Minerals and Mining Stocks

QUOTATIONS FROM IMPORTANT CENTERS

Coal Trade Review

New York, March 25—In the East both bituminous and anthracite trades continue quiet and without incident. Domestic demand is falling off with the season, and steam coal is not called for in large amounts.

In the West the important point is that the United Mine Workers' convention has receded from its demand for a renewal of the interstate agreement, and has consented to go into conference for a renewal of the present district agreements. The various conferences to be held cannot complete their work by April 1, and there will probably be some cessation of mining, for which many consumers are preparing by storing coal. Apparently the suspension will be an amicable one, not amounting to a strike. The conditions are made that the new agreements shall be for one year only, and that there shall be no reduction of wages. A report from the convention will be found on another page.

Coal Traffic Notes

Tonnage originating on Pennsylvania railroad lines east of Pittsburg and Erie, year to March 14, in short tons:

	1907.	1908.	Changes.
Anthracite.....	1,076,228	1,052,936	D. 23,292
Bituminous.....	7,624,212	6,561,256	D. 1,062,956
Coke.....	2,837,412	1,448,929	D. 1,388,483
Total.....	11,537,852	9,063,121	D. 2,474,731

Total decrease this year was 21.4 per cent.

Coal shipments from the Cumberland region in Maryland and West Virginia were 4,377,775 tons in 1906 and 4,310,885 tons in 1907; a decrease of 66,890 tons.

Bituminous coal and coke shipments, Pennsylvania and West Virginia, month of January, short tons:

	Coal.	Coke.	Total.
Balt. & Ohio.....	1,763,595	176,260	1,939,855
Buff., Roch. & Pitts.	424,486	42,523	467,009
Penn. lines, N. Y. C.	584,177	4,999	589,176
Pitts. & L. Erie.....	448,105	189,255	637,360
Norfolk & Western.	770,346	135,810	906,156
Total.....	3,990,709	548,847	4,539,556
Total, 1907.....	5,289,081	1,219,670	6,508,751

In addition the Baltimore & Ohio carried 108,636 tons anthracite in 1907, and 78,452 in 1908; decrease, 30,184 tons.

Coal receipts at St. Louis in January were 786,280 short tons in 1907, and 666,810 in 1908; decrease, 119,470 tons.

Coal receipts at Cincinnati in 1907, reported by Chamber of Commerce, short tons: River, 2,585,880; rail, 3,413,320; total, 5,999,200 tons. This is a decrease of 959,080 tons from the preceding year.

Coal tonnage, Ohio Coal Traffic Association, month of January, short tons:

	1907.	1908.	Changes.
Hocking Valley.....	348,583	185,576	D. 163,007
Toledo & Ohio Cent..	161,409	81,131	D. 80,278
Baltimore & Ohio....	183,856	139,103	D. 44,753
Wheeling & L. Erie..	307,745	181,611	D. 126,134
Cleve., Lorain & Wh.	226,483	170,549	D. 55,934
Zanesville & Western	123,088	89,267	D. 33,821
Toledo Div., Pen. Co.	260,071	133,613	D. 126,458
L. Erie, Alliance & Wh.	108,606	87,267	D. 21,339
Marietta, Col. & Clev.	1,485	6,237	I. 4,752
Total.....	1,721,326	1,074,354	D. 646,972

The total this year shows a decrease of 37.6 per cent.

Coastwise coal shipments from the chief Atlantic ports in January were, in long tons:

	Anthracite.	Bitum.	Total.	PerCt.
New York....	1,323,002	892,166	2,215,168	61.5
Philadelphia	211,379	428,431	639,810	17.8
Baltimore....	15,747	355,040	370,787	10.3
Newp't News	.....	186,070	186,070	5.2
Norfolk.....	.. ..	185,561	185,561	5.2
Total.....	1,550,128	2,047,268	3,597,396	100.0
Total, 1907.	1,626,913	1,717,806	3,344,719	.....

Increase, 252,677 tons, or 7.6 per cent. New York includes all the New York harbor shipping points.

New York

Anthracite

March 25—With the exception of pea coal all sizes of anthracite are in good supply and in light demand. Prepared sizes are flat, consumers waiting for the usual reduction on April 1. Prices are as follows: Broken, $4.75; egg, stove and chestnut, $5; pea, $3.25@3.50; buckwheat No. 1, $2.75@3; buckwheat No. 2 or rice, $2.15@2.25; barley, $1.75; all f.o.b. New York harbor.

Bituminous

No improvement is evident in the soft-coal market. All territories are suffering from the depression and there are not many contracts, these days, to relieve the monotony of the situation. Good grades of steam coal may be bought in New York harbor for $2.55@2.65 per ton. Mines are curtailing their production.

Transportation from mines to tide continues good and there is an over-supply of cars. In the coastwise trade a large number of vessels are tied up.

Birmingham

March 23—The coal situation in Alabama shows no change. The mine inspectors report that the production is somewhat better than it was last month, but not near normal. General Manager J. R. Pill, of the Galloway Coal Company, announces that some coal is being sold for delivery in territories heretofore supplied by Western mines. There are between 3500 and 5000 coal miners and mine workers out of employment in Alabama at present, it is estimated. Coal prices have not fallen off much, as compared to the change in pig-iron quotations.

Coke is in only fair demand. The furnace operations regulate this product almost entirely in Alabama, though some few orders from Texas and Mexico are handled.

Chicago

March 23—Following the reports that there will be no general strike of the miners in the bituminous regions of the Middle West, the coal market has been flat to stale in the last week. Buying for steam purposes is at a low ebb; contract requirements for the coming year are not being made to any large extent, and the domestic market is, as always at this time of the year, given to light and infrequent sales.

Illinois and Indiana lump bring $1.80@2.30; run-of-mine, $1.70@1.80, and screenings, $1.30@1.40. Smokeless holds up to $3.30 for Pocahontas and New River; Hocking to $3.15, and Youghiogheny to $3.15 for ¾-in. gas.

Cleveland

March 24—Cleveland shippers have chartered vessel capacity for 500,000 tons of coal at the same carrying charges as last year, that is, 30c. from Ohio points to the head of Lake Superior, and 40c. to Milwaukee.

Spot coke is quoted at $2.30@2.50 at the ovens and spot furnace coke at $1.70@1.80 per ton.

Indianapolis

March 24—President W. D. Van Horn, of the Indiana miners, has already taken steps to negotiate as a district with the Indiana operators. If negotiations are opened before April 1, it will insure a continuation of work during April, and the operators are anxious for this, since the demand for Indiana coal is unusually strong at present, although the price remains the same.

Pittsburg

March 24—Operators in this district seem determined to hold prices on the basis of $1.15 a ton for mine-run coal at the mine on contract and $1.20 for current business. The independent interests have been storing coal. The mines in the Pittsburg district are being operated to

about 75 per cent. of capacity, although 30 per cent. would take care of all the business at this time. It is reported here that the United States Steel Corporation has requested the Pittsburg Coal Company to prevent a strike, as it would seriously disturb conditions. Independent operators declare that they will not endeavor to effect a settlement with the miners for a few weeks at least. They say they are willing to continue the present mining rate, which is on the basis of 85c. a ton for pick mining over a 1¼-in. screen. The rivers are navigable, but no coal is being shipped.

Connellsville Coal—Prices have declined again and sales of spot furnace coke have been made this week at $1.65 a ton, but on contract quotations remain at $1.80@1.90. A drop has been made in foundry coke for both spot and on contract, to $2.10@2.30. The *Courier* in its weekly report gives the production in the two Connellsville regions at 160,369 tons. The shipments amounted to 6789 cars, distributed as follows: To Pittsburg, 2829 cars; to points west of Connellsville, 3396 cars; to points east of Connellsville, 564 cars.

Foreign Coal Trade

Coal bunkered, or supplied to steamships in foreign trade, at United States ports in January was 458,711 tons in 1907, and 519,390 tons in 1908; increase, 60,679 tons. Adding exports, previously reported, this makes the total coal sold for consumption outside of the United States in January, 1,220,081 tons in 1907, and 1,425,339 in 1908; increase, 205,249 tons.

Coal exports from Great Britain, with coal supplied to steamships in foreign trade, for the two months ended Feb. 29 were, in long tons:

	1907.	1908.	Changes.
Coal	9,026,070	9,360,445	I. 334,375
Coke	159,321	191,762	I. 32,441
Briquets	217,520	259,298	I. 41,778
Total exports	9,402,911	9,811,505	I. 408,594
Steamer coal	2,921,323	3,147,257	I. 225,934
Total	12,324,234	12,958,762	I. 634,528

Exports to the United States this year, included above, were 12,231 tons, of which 6005 tons were for Pacific ports.

Iron Trade Review

New York, March 25—The quiet of the market has not been disturbed by any special incident during the week. A few more orders for structural steel are reported, and some contracts of fair size are pending. Some orders for rails have also been given, but in rather moderate lots. Small sales of pig iron continue, and some furnaces are still reported as shading prices to secure these. A heavy order for locomotives from the New York Central constitutes the most important new business of the week.

At the meeting of the advisory committee of the steel trade last week, it was decided to maintain prices of all finished products at present figures. Another conference is to be held in April. Reports show about 50 per cent. of mill capacity employed.

Open-hearth Steel—The American Iron and Steel Association reports the production of open-hearth steel for the year as follows, in long tons:

	1906. Tons.	1906. Per Ct.	1907. Tons.	1907. Per Ct.
Acid	1,321,653	12.0	1,269,773	11.0
Basic	9,658,760	88.0	10,279,315	89.0
Total	10,980,413	100.0	11,549,088	100.0

In 1907 the total included 745,877 tons of direct castings. The increase in production of all open-hearth steel was 568,675 tons, or 5.1 per cent.

Southern Pig Iron Shipments—The following statement, compiled by the Southern railroads, shows shipments of iron from Kentucky, Tennessee and Alabama furnaces in 1907:

	Tons.	Per Ct.
Points east	169,128	10.6
Points west	1,004,008	63.2
Buffalo-Pittsburg zone	40,873	2.6
Southern points	371,496	23.4
For export	2,712	0.2
Total	1,588,217	100.0

The statement does not include the Virginia furnaces; nor does it include pig iron shipped to the Ensley steel works. Points west include all the territory west of Buffalo and north of the Ohio.

Baltimore

March 23—Exports for the week included 393 tons rails and 264 tons steel ties to Mexico; 899 tons steel rails to Panama; 1324 tons tin-plate bars to Great Britain. There was also exported 128,526 lb. aluminum to Great Britain.

Birmingham

March 23—With the exception of the sale of three or four lots of more than 300 tons, there has been nothing unusual. The make has been curtailed a little by the blowing out of the furnace at Thomas. The activity at the steel plant of the Tennessee company at Ensley continues. The placing of heavy machinery in the steel rail mill is likely to cause a shut-down there shortly, but it is announced that none of the labor employed about the plant will be without work, as the rolling mills at Bessemer will be started up.

All sales of pig iron are in small lots. The report from the general offices of the companies is to the effect that $13 per ton, No. 2 foundry, is the quotation. Reports from outside indicate that the price is between $12 and $13 for No. 2 foundry.

Pig iron from the Bessemer furnaces of the Tennessee company is being used in filling the order from Genoa, Italy, for 3500 tons.

Chicago

March 23—Pig iron continues to be bought very conservatively. An order of 2000 tons foundry iron has given encouragement to the local market. Orders for delivery in the next two to three months are being placed slowly and do not amount to over 500 tons each at the most. Southern furnaces get these orders.

The quotation of $13 Birmingham for Southern holds fairly good, with 50c. margin for large lots. Northern iron is at $17.50 and Lake Superior charcoal at $21.50 for small lots. Sales of iron and steel products, though light, are slowly improving. Coke holds at $5.20 for the best Connellsville, with supply well regulated.

Cleveland

March 24—The pig-iron business is at a standstill. Quotations are nominally: Bessemer, $17.90; No. 1 foundry, $17.85; No. 2, $17.35; No. 3, $16.85; No. 2 Southern, $16.85@17.35; gray forge, $16@16.85; Lake Superior charcoal, $22@25.

There are some small orders for structural material reported.

Pittsburg

March 24—Iron- and steel-market conditions continue dull. There was a slight improvement in pig iron as to sales, but prices were lower. As a result of the action of the general committee of steel men in New York last week, prices on finished steel products are being strictly maintained. The usual run of small lots in various lines is being bought by consumers who only take what they require for immediate use. It is understood that present prices are to continue until July 1 at least.

More idle mills, or departments in plants that are operating, have been started this week, but a number of mills closed, so that no material improvement is noticed. The Carnegie Steel Company has taken an order for 1500 tons of light rails for export, and likely will land an order for standard sections for a foreign market. The American Sheet and Tin Plate Company is operating 186 tin-plate mills and about 45 per cent. of its sheet capacity. Independent tin-plate interests are operating about 60 per cent. of their capacity.

Pig Iron—The only activity in the pig-iron market this week is malleable bessemer. One interest sold 300 tons at $16, Valley furnace, and another had inquiries for over 6000 tons, some for deliveries running through the second half. The iron, however, will not be sold unless the price is made more attractive. No transaction in bessemer iron is recorded, and the price remains nominally at $17 at furnace. Foundry iron has declined and for No. 2 it is believed $15 can be done. Gray forge is down to $14.50, a drop of 50c. Basic iron also is weaker, and there would be no difficulty in placing an order at

$15.50, Valley furnaces. Some surprise was occasioned by the blowing in of the Clinton furnace in Pittsburg this week. There is considerable iron in stock in the valleys and some of the large steel interests have good supplies.

Steel—Bessemer and open-hearth billets, $28, Pittsburg; sheet-bars and tin-plate-bars, $29.50, delivered. Plates remain at 1.70c.; merchant-steel bars, 1.60c.

Sheets—The market shows a slight improvement. Black sheets, 2.50c., and galvanized, 3.55c. for No. 28 gage.

Ferro-manganese—The market is weak, and $45 for prompt delivery can be shaded.

Foreign Iron Trade

The German Iron and Steel Union reports the output of the German blast furnaces in January as follows, in metric tons:

	1907 Tons.	1907 PerCt.	1908 Tons.	1908 PerCt.
Foundry iron	177,543	16.7	192,456	18.1
Forge iron	69,503	6.5	57,706	5.5
Steel pig	87,493	8.2	89,462	8.4
Bessemer pig	40,712	3.9	39,303	3.7
Thomas pig	686,901	64.7	682,402	64.3
Total	1,062,152	100.0	1,061,329	100.0

There were increases of 14,913 tons in foundry iron and of 1969 tons in steel pig, which includes ferromanganese, ferrosilicon, spiegeleisen and all similar alloys; decreases of 11,797 tons in forge iron, 1409 in bessemer pig and 4499 in Thomas, or basic, pig. The total decrease from last year was 823 tons, or 0.1 per cent.

Metal Market

NEW YORK, Mar. 25.

Gold and Silver Exports and Imports

At all United States Ports in Feb. and year.

Metal.	Exports.	Imports.	Excess.
Gold:			
Feb. 1908..	$ 1,967,597	$ 2,802,431	Imp. $ 834,834
" 1907..	1,127,059	3,329,867	" 2,202,808
Year 1908..	2,411,797	13,734,964	" 11,323,167
" 1907..	3,577,031	6,600,372	" 3,023,341
Silver:			
Feb. 1908..	4,108,774	3,409,777	Exp. $698,997
" 1907..	4,843,970	3,721,988	" 1,121,982
Year 1908..	8,256,918	7,031,651	" 1,225,267
" 1907..	9,610,935	7,379,029	" 2,231,906

Exports from the port of New York, week ended March 21: Gold, $12,250, to Haiti; silver, $952,012, chiefly to London. Imports for the week: Gold, $678,177, chiefly from Cuba; silver, $54,940, from the West Indies and Mexico.

Gold and silver movement in France, month of January:

Gold:	1907.	1908.
Imports	Fr. 13,052,000	Fr. 30,585,000
Exports	26,721,000	2,275,000
Excess	Exp. Fr. 13,669,000	Im. Fr. 28,310,000
Silver:		
Imports	13,294,000	8,351,000
Exports	8,300,000	20,608,000
Excess	Imp. Fr. 4,994,000	Ex. Fr. 12,257,000

Imports of nickel and copper coins, 3000 fr. in 1907, and 8000 fr. in 1908; exports, 5000 fr. in 1907, and 26,000 fr. this year.

The foreign trade of the United States for the two months ended Feb. 29 is reported as follows by the Bureau of Statistics of the Department of Commerce and Labor:

Merchandise:	1907.	1908.
Exports	$ 348,814,165	$ 374,036,516
Imports	249,592,617	164,123,915
Excess, exports	$ 99,221,548	$ 209,912,601
Add excess of exports, silver		1,225,267
Total		$ 211,137,868
Deduct excess of imports, gold		11,323,167
Net export balance		$ 199,814,701

The gold and silver movement in detail is given in the table at the head of this column.

Silver Market

SILVER AND STERLING EXCHANGE.

Mar.	Sterling Exchange.	Silver. New York, Cents.	Silver. London, Pence.	Mar.	Sterling Exchange.	Silver: New York, Cents.	Silver: London, Pence.
19	4.8595	55¼	25⅝	23	4.8605	55⅜	25 1/16
20	4.8600	55⅜	25⅝	24	4.8590	55¼	25⅝
21	4.8600	55¼	25½	25	4.8600	55¼	25⅝

New York quotations are for fine silver, per ounce Troy. London prices are for sterling silver, 0.925 fine.

Messrs. Pixley & Abell report silver shipments from London to the East for the year to March 12:

	1907.	1908.	Changes.
India	£3,172,210	£1,425,838	D. £1,746,372
China	.....	496,400	I. 496,400
Straits	85,050	78,270	D. 6,780
Total	£3,257,260	£2,000,508	D. £1,256,752

Imports for the week were £7000 from Chile, £6000 from the West Indies and £225,000 from New York; £238,000 in all. Exports were £25,300 to India.

Indian exchange has been rather easy, on light demand. The Council bills offered in London brought an average of 15.91d. per rupee.

Other Metals

Mar.	Copper. Lake, Cts. per lb.	Copper. Electrolytic, Cts. per lb.	Copper. London, £ per ton.	Tin. Cts. per lb.	Lead. Cts. per lb.	Spelter. New York, Cts. per lb.	Spelter. St. Louis, Cts. per lb.
19	12⅞ @13⅛	12¾ @12⅞	59	30½	3.90 @4.00	4.65 @4.70	4.50 @4.55
20	12⅞ @13⅛	12¾ @12⅞	58⅞	31	3.90 @4.00	4.65 @4.70	4.50 @4.55
21	12⅞ @13⅛	12¾ @12⅞	.....	31	3.90 @4.00	4.65 @4.70	4.50 @4.55
23	13 @13⅛	12¾ @13	60⅛	31¼	3.90 @4.00	4.65 @4.70	4.50 @4.55
24	13⅛ @13¼	13 @13¼	60⅝	31¾	3.90 @4 00	4.65 @4.70	4.50 @4.55
25	13⅛ @13⅜	13 @13¼	60⅜	32½	3.90 @4.00	4.65 @4.70	4.50 @4.55

London quotations are per long ton (2240 lb.) standard copper, which is now the equivalent of the former g.m.b's. The New York quotations for electroytic copper are for cakes, ingots or wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is 0.125c. below that of electrolytic. The quotations for lead represent wholesale transactions in the open market. The quotations on spelter are for ordinary Western brands; special brands command a premium.

Copper—The market is steadily improving. Manufacturers report an increasing business which has encouraged them to come into the market for copper more freely, for future as well as early delivery, and in consequence a good business was transacted at advancing prices. The demand from Europe continues, notwithstanding the large exports which have taken place, and consumption over there appears to be very good. At the close Lake copper is quoted at 13⅛@13⅜c.; electrolytic in ingots, cakes and wirebars, 13@13¼c. The average for the week at which casting copper was quoted is 12½@12¾c.

The standard market in London fluctuated narrowly. On Thursday and Friday it was £59 for spot, £59 5s. for three months. On Monday there was considerable buying and prices advanced to £60 10s. for spot, £60 17s. 6d. for three months. The market on Tuesday was 2s. 6d. higher, and the close is cabled at £60 7s. 6d. for spot, £60 15s. for three months. Transactions during these days were large.

Refined and manufactured sorts we quote: English tough, £60@61; best selected, £63@63 10s.; strong sheets, £66@67.

The Victoria Copper Mining Company, of Michigan, produced 1,207,237 lb. of copper in 1907, which sold at an average of 18.08c.per lb. The sales during 1907 amounted to 949,801 lb., which fetched an average of 19.2c.; and 257,436 lb. were sold in January at an average of 13.6c.

According to the report of the Greene Consolidated Copper Company, its production during 17 months ending with Dec. 31, 1907, was 58,180,856 lb. of refined copper. The report does not state how much remained unsold at the end of this period, but states that "the average price received for fine copper delivered was 18.588c." The quotational average for electrolytic copper during the same period was 20.4c.

Exports of copper for the week from New York and Philadelphia were 4123 long tons. Our special correspondent gives the exports from Baltimore at 305 long tons.

Imports of copper into Germany in January were 14,284 metric tons. Exports were 337 tons, leaving the net imports 13,947 tons.

Copper Sheets and Wire—The base price for wire is 14½c. per lb. For sheets, cold rolled or hard, 18c.; hot rolled or soft, 17c. per pound.

Tin—Large transactions have taken place in the London market, which was extremely strong during the past week. Advances were scored from day to day and the close is cabled at £146 10s. for spot, £143 17s. 6d. for three months.

The domestic market was equally strong and noticeable for a scarcity of prompt metal. Consumers, however, maintain

their careful attitude and will buy only to fill their absolute requirements. Prices at the close are quoted 32¼@32½ cents.

Tin exports from the Straits in January were: United States, 2156 long tons; Great Britain, 3126; European continent, 715; China and India, 78; total, 6075 tons, an increase of 1206 tons over January of last year.

Lead—The market is quiet and a few transactions are reported. Lead in New York is quoted at 3.90@4 cents.

The London market for Spanish lead has been strong and advancing, and closes at £14 10s., with English lead at £14 12s. 6d.

St. Louis Lead Market—The John Wahl Commission Company reports as follows: Lead strong and still slowly advancing. The latest sales here are on a basis of 3.77½@3.80c. for Missouri brands.

Spelter—The market is dull. There is little demand, and on the other hand no pressure to sell. Present prices are unremunerative for smelters and they are disposed to curtail production rather than force sales. Spot metal at New York is quoted at 4.65@4.70c., while St. Louis delivery is quoted 4.50@4.55 cents.

The European market is unchanged, good ordinaries being quoted £21 2s. 6d., specials £21 7s. 6d. per ton.

Zinc Sheets—The base price is $7 per 100 lb.—less discount of 8 per cent.—f.o.b. cars at Lasalle and Peru.

Antimony—The market continues weak; sales are light and only for immediate needs. Prices abroad are higher than in the New York market, which prohibits importation. Quotations are 8⅞@9⅛c. for Cookson's, 8½@9c. for Hallett's and 7¾@8¼c. for ordinary brands.

Aluminum—The current price for No. 1 ingots, in ton lots, is 33c. per lb. For rods and wire, No. 0000 to 10, base price is 38c. For sheets, No. 13 to 24, B. & S. gage, base price is 40c. Tubes, 1¼ to 3½ in., base 50c. Higher prices are charged for small lots.

Cadmium—The price is $1.25 f.o.b. Cleveland in 100-lb. lots. A higher price is asked for smaller lots.

Nickel—For large lots, New York, the chief producer quotes 45@50c. per lb. according to size and terms of sale. For small quantities, 50@65c., same delivery.

Quicksilver—New York quotations are $45 per flask for lots of 100 flasks or over, and $46 for smaller orders. San Francisco quotations are $44.50@45.50 for domestic orders; for export nominal, at about $1.50 lower. The London price is £8 5s. per flask, with £8 3s. 9d. quoted from second hands.

Platinum—A further recession of 50c. per troy ounce has brought quotations to $27 for hard platinum, $24.50 for ordinary, and $17 for scrap.

Missouri Ore Market

Joplin, Mo., March 21—The highest price of the week was $40 per ton, on a base price of $36, ranging down to $34 per ton of 60 per cent. zinc, averaging, all grades, $33.56 per ton. The highest lead price was $52 per ton, medium grades selling at $49@51, and all grades averaging $49.90 per ton.

The Lanyon Zinc Company has cleaned up all the reserve stock in the district for sale on a base price of $35@35.50 per ton of 60 per cent. zinc, the local purchasing agent having a free hand to buy all offerings on this base. In the lead market, the St. Louis Smelting and Refining Company, recouping the losses to the Picher Lead Company of last week, this week advanced the market to $52 per ton, which the Picher did not meet, having secured a supply last week.

Following are the shipments of zinc and lead from the various camps of the district for the week ending March 21:

	Zinc, lb.	Lead, lb.	Value.
Webb City-Carterville	2,959,070	506,850	$62,975
Joplin	2,371,560	289,960	49,937
Duenweg	1,268,280	82,690	23,627
Alba-Neck	824,340	.....	15,250
Galena	850,920	25,080	15,092
Prosperity	390,670	192,690	11,458
Oronogo	365,700	10,190	6,699
Aurora	368,860	6,250	5,665
Granby	510,000	40,000	5,500
Spurgeon	218,810	25,440	3,548
Sarcoxie	140,320	.....	2,315
Carthage	121,850	.....	2,253
Zincite	81,600	7,130	1,563
Cave Springs	63,100	.....	1,104
Peoria	80,230	.....	1,042
Carl Junction	56,960	.....	996
Wentworth	48,980	.....	768
Reeds	32,510	.....	357
Totals	10,753,760	1,186,280	$210,149
12 weeks	101,969,830	14,310,010	$2,135,637

Zinc value, the week, $180,542; 12 weeks, $1,786,724
Lead value, the week, 29,607; 12 weeks, 348,913

Average ore prices in the Joplin market were, by months:

ZINC ORE AT JOPLIN.			LEAD ORE AT JOPLIN.		
Month.	1907.	1908.	Month.	1907.	1908.
January	45.84	35.56	January	83.58	46.88
February	47.11	34.92	February	84.58	49.72
March	48.66	.....	March	82.75	.....
April	48.24	.....	April	79.76	.....
May	45.98	.....	May	79.56	.....
June	44.82	.....	June	73.66	.....
July	45.79	.....	July	58.18	.....
August	43.22	.....	August	59.54	.....
September	40.11	.....	September	53.52	.....
October	39.83	.....	October	51.40	.....
November	35.19	.....	November	43.40	.....
December	30.87	.....	December	37.71	.....
Year	43.68	.....	Year	68.90	.....

Wisconsin Ore Market

Platteville, Wis., March 21—From $36 to $37 per ton was the base price paid for zinc ore during the week; no premium was paid over the base price. A number of high-grade producers have been temporarily closed down for various repairs. The highest price paid for lead ore was $24@25 per thousand for 80 per cent. lead.

Shipments for the week ended March 21 were:

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Benton	327,950	.....	.....
Rewey	187,000	.....	.....
Livingston	160,000	.....	.....
Hazel Green	150,100	.....	.....
Linden	130,520	.....	.....
Mineral Point	125,600	.....	.....
Platteville	76,930	49,065	.....
Total	1,158,100	49,065	.....
Year to Mar. 21	15,122,520	1,025,485	79,800

Several new mills will probably be put up in the district soon.

Chemicals

New York, March 25—The general market shows no improvement except in small jobbing lots. Prices as a whole are not lower, but orders are few. White arsenic is a trifle easier, the price having shaded ⅛c. to 4⅞c. per lb. in carload lots.

Copper Sulphate—The market shows a little improvement; some fair sales for agricultural purposes are reported, but less than usual at this time. Prices unchanged at $5 per 100 lb. for carload lots and $5.25 for smaller quantities.

Nitrate of Soda—The market is firmer and demand has increased. Supplies are about normal, except for spot delivery. Prices are unchanged at 2.40c. for all positions of 1908; 2.37½c. for 1909; and 2.32½ for 1910. The 96-per cent. grade sells 5c. per 100 lb. higher.

Mining Stocks

New York, March 25—The general stock markets have shown increased strength and activity through the week, but the trading is still largely professional. The public does not seem inclined to speculate much as yet; nevertheless there is a better feeling, so that securities are being quietly placed on a larger scale than they have been for months past.

The market in mining stocks has been active, especially in the coppers, and considerable buying has been done at advancing prices. The Nevada copper stocks have been specially in demand.

On the Exchange there was one sale of Homestake, of South Dakota, 50 shares changing hands at $71.50 per share.

Boston

March 24—After a trifling setback the middle of last week, mining shares have again strengthened and today saw the broadest and most active market in this class of stocks for some time. The strength of the metal, with the continued ease of the money market has changed sentiment and the public is becoming interested in stocks somewhat. Tamarack had a bad break from $63 to $57, one day last week, but is now back to $64. The movement was considered entirely professional.

Amalgamated Copper has surprised the

rank and file because of its continued strength; it rose to $59.50 today, with slight setback from this price. Utah Consolidated fell $1.50 to $39, but is now up to above $41. The declaration of the same dividend as three months ago, namely 50c. quarterly, has inspired confidence. Calumet & Arizona is up $107 on declaration of the same dividend as three months ago, $1. Copper Range, North Butte and Butte Coalition have been the leaders in market movements during the week.

The curb has also been strong and active, reflecting the movements of the greater market. Lawson-Mexican has been an active feature. The Ely and Nevada stocks have also been conspicuously active and strong.

STOCK QUOTATIONS

NEW YORK Mar. 24	
Name of Comp.	Clg.
Alaska Mine	7/8
Am.Nev.M.&P.Co.	....
Amalgamated	59 1/8
Anaconda	38 7/8
Balaklala	2 3/8
British Col. Cop.	5
Buffalo Cobalt	....
Butte & London	....
Butte Coalition	22 1/2
Butte Cop. & Zinc	....
Cobalt Contact	....
Colonial Silver	3/8
Cum. Ely Mining	9 1/8
Davis Daly	3 7/8
Dominion Cop.	2 1/8
Douglas Copper	5 5/8
Ei Rayo	1 3/8
Foster Cobalt	.60
Furnace Creek	.20
Giroux Mine	3 1/2
Gold Hill	3/4
Granby, New	....
Greene Gold	5/8
Greene G. & S	1/2
Greenw'r & D.Val.	.75
Guanajuato	2 1/4
Guggen. Exp.	155
Hanapah	....
McKinley Dar.	.70
Micmac	4 3/4
Mines Co. of Am.	1 1/2
Mitchell Mining	5/8
Mont.Sho. C.(New)	3
Nev. Utah M. & S	4 7/8
Newhouse M. & S	7 3/4
Nipissing Mines	7
Old Hundred	3/4
Silver Queen	1
Stewart	3/4
Tennessee Cop'r	37
Union Copper New	1/16
Utah Apex	4 1/4
Utah Copper	32 3/4
West Columbus	....

N. Y. INDUSTRIAL	
Am. Agri. Chem.	18
Am. Smelt. & Ref.	73 1/4
Am. Sm. & Ref., pf.	96
Bethlehem Steel	....
Colo. Fuel & Iron	22 3/4
Federal M. & S., pf.	72
Inter. Salt	10 1/2
National Lead	58 3/4
National Lead, pf.	94
Pittsburg Coal	....
Republic I. & S.	19
Republic I. & S., pf.	73
Sloss-Sheffield	51 1/2
Standard Oil	514 1/2
Tenn. C. & I.	....
U. S. Red. & Ref.	....
U. S. Steel	35 3/8
U. S. Steel, pf	99 5/8
Va. Car. Chem.	20 1/2
Va. I. Coal & Coke	....

ST. LOUIS Mar. 21		
N. of Com.	High.	Low.
Adams	.25	.20
Am. Nettie	.04	.02
Center Cr'k	2.00	1.50
Cent. C. & C.	65.00	62.00
C.C. & C. pd.	76.00	74.00
Cent. Oil	95.00	90.00
Columbia	4.00	2.00
Con. Coal	20.00	18.00
Doe Run	125.00	115.00
Gra. Bimet.	.25	.20
St. Joe.	15.00	14.00

BOSTON Mar. 24	
Name of Comp.	Clg.
Adventure	....
Allouez	26
Am. Zinc	....
Arcadian	....
Atlantic	10 1/2
Bingham	.87
Boston Con	15
Calumet & Ariz.	105
Calumet & Hecla*	650
Centennial	....
Con. Mercur	....
Copper Range*	65 1/8
Daly West	8 3/8
Franklin	8
Greene-Can.	8 3/4
Isle Royal	20 3/8
La Salle	15
Mass	2 3/4
Michigan	11
Mohawk	50
Mont.C.&C. (new)	1
Nevada	12 7/8
North Butte	55
Old Colony	....
Old Dominion	38 1/4
Osceola	84
Parrot	19
Phoenix	....
Quincy	85
Rhode Island	3 1/8
Santa Fe	2
Shannon	12 3/4
Superior	....
Tamarack	64
Trinity	16 1/4
United Cop., com.	4 5/8
U. S. Oil	10 1/4
U. S. Smg. & Ref.	33 3/4
U.S.Sm. & Re., pd.	40 3/4
Utah Con	40 3/4
Victoria	3 1/4
Washington	....
Winona	....
Wolverine*	125
Wyandotte	.65

*Ex. Div. †Ex. Rights.

BOSTON CURB	
Ahmeek	60
Ariz. Com	....
Black Mt	....
East Butte	4 3/8
Hancock Con.	6 1/4
Keweenaw	5
Majestic	1 1/2
Raven	1 3/8
Shawmut	.40
Superior & Pitts.	13 5/8
Troy Man	....

LONDON Mar. 25		
Name of Com.	Clg.	
Dolores	£1	5s 0d
Stratton's Ind.	0	3 3
Camp Bird	0	13 1 1/2
Esperanza	1	4 4 1/2
Tomboy	1	8 9
El Oro	1	2 6
Oroville	0	11 3
Somera	..	.. .
Utah Apex	..	.. .
Ariz. Cop., pfd.	..	.. .
Ariz. Cop., def.	..	.. .

Cabled through Wm. P. Bonbright & Co., N.Y.

NEVADA STOCKS. March 25.

Furnished by Weir Bros. & Co., New York.

Name of Comp.	Clg.	Name of Comp.	Clg.
TONOPAH STOCKS		Homestake King.	.38
Belmont	1.06 1/2	Montgomery Mt.	.11
Extension	.87 1/2	Mont. Shoshone C.	2.87 1/2
Golden Anchor	.03	Original Bullfrog.	.02 1/2
Jim Butler	.29	Tramp Cons	.19
MacNamara	.45	MANHAT'N STOCKS	
Midway	.55	Manhattan Cons.	.16
Montana	1.65	Manhat'n Dexter.	.08
North Star	.11	Jumping Jack	.04
Tono'h Mine of N.	6.00	Stray Dog	.05
West End Con	.25	Indian Camp	.04
GOLDFI'D STOCKS		MISCELLANEOUS	
Adams	.05	Bonnie Clare	.17
Atlanta	.25	Golden Boulder	.07
Blue Bell	.08	Lee Gold Grotto	.03
Blue Bull	.12	Nevada Hills	2.75
Booth	.19	Nevada Smelting.	1.12 1/2
Columbia Mt	.19	Pittsburgh S. Pk.	1.12
Comb. Frac	.70	Round Mt. Sphinx	.30
Cracker Jack	.07		
Dia'dfield B. B. C.	.17		
Goldfield Belmont	.16		
Goldfield Con	5.12 1/2		
Goldfield Daisy	1.36		
Great Bend	.43		
Jumbo Extension	.35		
Katherine	.05		
Kendall	.17		
Lone Star	.09		
May Queen	.06 1/2		
Ore	.08		
Red Hill	.25		
Roanoke	.02		
Sandstorm	.33		
Silver Pick	.25		
St. Ives	.28		
Triangle	.06		
BULLFROG STOCKS			
Bullfrog Mining	.08		
Bullfrog Nat. B.	.09		
Gibraltar	.07		
Gold Bar	.21		

COLO. SPRINGS Mar. 21

Name of Comp.	Clg.
Acacia	7
Black Bell	....
C. C. Con	....
Dante	....
Doctor Jack Pot	....
Elkton	51 1/2
El Paso	32
Findlay	30
Gold Dollar	....
Gold Sovereign	3 5/8
Isabella	36 1/2
Index	....
Jennie Sample	3 1/4
Jerry Johnson	....
Mary McKinney	31
Pharmacist	3 1/2
Portland	1.04
Un. Gold Mines	....
Vindicator	83
Work	13 3/8

New Dividends

Company.	Payable.	Rate.	Amt.
Am. Ag. Chem., pfd	Apr. 15	$3.00	$544,590
Buffalo Mines	Apr. 1	0.03	27,000
Calumet & Arizona	Apr. 25	1.00	200,000
Central C. & C., com	Apr. 15	1.50	76,875
Central C. & C., pfd	Apr. 15	1.25	23,438
Coi. & Hocking C. & I., pfd.	Apr. 1	1.50	103,866
Copper Range Con	Apr. 1	1.00	383,781
Dominion Coal, com	Apr. 1	1.00	150,000
Florence (Goldfield)	Apr. 1	0.10	125,000
Gen. Chemical, pfd	Apr. 2	1.50	150,000
Guggenheim Exp.	Apr. 7	2.50	262,500
Inter. Nickel, pfd	May 1	1.50	131,123
New Idria	Apr. 1	0.30	30,000
Nipissing	Apr. 20	0.15	180,000
N. S. St. & Coal, com	Apr. 15	1.50	74,814
N. S. St. & Coal, pfd	Apr. 15	2.00	20,600
Penn. Salt Mfg.	Apr. 15	3.00	180,000
Republic I. & S., pfd	Apr. 1	1.75	357,296
Rio Tinto, com	Mar.	9.60	3,600,000
Sloss. Sheff., pfd	Apr. 1	1.75	117,250
Utah Con	Apr. 15	0.50	150,000
Va. Car. Chem., pfd	Apr. 15	2.00	360,000
Westmoreland Coal	Apr. 1	5.00	150,000
Wolverine	Apr. 1	5.00	300,000
Work	Apr. 4	0.01	15,000

Assessments

Company.	Delinq.	Sale.	Amt.
Blackjack Con., Utah	Feb. 20	Mar. 16	$0.03
Burlington, Utah	Feb. 17	Mar. 5	0.01
Butte & Yerrington, Nev.	Mar. 25	Apr. 16	0.02
Caledonia, Nev.	Mar. 10	Apr. 1	0.10
Challenge, Nev.	Feb. 25	Mar. 17	0.10
Con. Imperial, Nev.	Mar. 11	Apr. 2	0.01
Duleck, Cal.	Mar. 6	Mar. 23	0.05
Eastern & Western, Utah	Mar. 16	Apr. 6	0.01
Exchequer, Nev.	Feb. 27	Mar. 19	0.05
Golden Fleece, Cal.	Feb. 8	Mar. 7	2.50
Hannapah, Utah	Feb. 6	Mar. 10	0.01
Jenny Lind, Cal.	Mar. 10	Mar. 26	0.02
Julia, Nev.	Feb. 24	Mar. 18	0.03
Quincy, Jr., Utah	Mar. 21	Apr. 20	0.02
Scottish Chief, Utah	Mar. 18	Apr. 10	0.01
Skylark, Utah	Mar. 27	Apr. 14	0.01
Sierra Queen, Cal.	Mar. 15	Apr. 3	0.02
Trumbull Oil, Cal.	Feb. 24	Mar. 24	0.01
Union Con., Nev	Mar. 2	Mar. 26	0.10
Western Mines, Nev.	Mar. 16	Apr. 23	0.01 1/2

Monthly Average Prices of Metals

AVERAGE PRICE OF SILVER

Month.	New York.		London.	
	1907.	1908.	1907.	1908.
January	68.673	55.678	31.769	25.738
February	68.835	56.000	31.852	25.855
March	67.519	.....	31.325	.....
April	65.462	.....	30.253	.....
May	65.981	.....	30.471	.....
June	67.090	.....	30.893	.....
July	68.144	.....	31.366	.....
August	68.745	.....	31.637	.....
September	67.792	.....	31.313	.....
October	62.435	.....	28.863	.....
November	58.677	.....	27.154	.....
December	54.565	.....	25.362	.....
Year	65.327	.....	30.188	.....

New York, cents per fine ounce; London, pence per standard ounce.

AVERAGE PRICES OF COPPER

	NEW YORK.				LONDON.	
	Electrolytic		Lake.			
	1907.	1908.	1907.	1908.	1907.	1908.
January	24.404	13.726	24.825	13.901	106.739	62.386
February	24.869	12.905	25.236	13.098	107.356	58.786
March	25.065	.....	25.560	.....	106.594	.....
April	24.224	.....	25.260	.....	98.625	.....
May	24.048	.....	25.072	.....	102.375	.....
June	22.665	.....	24.140	.....	97.272	.....
July	21.130	.....	21.923	.....	95.016	.....
August	18.356	.....	19.255	.....	79.679	.....
September	15.565	.....	16.047	.....	68.375	.....
October	13.169	.....	13.551	.....	60.717	.....
November	13.391	.....	13.870	.....	61.226	.....
December	13.163	.....	13.393	.....	60.113	.....
Year	20.004	.....	20.661	.....	87.007	.....

New York, cents per pound. Electrolytic is for cakes, ingots or wirebars. London, pounds sterling, per long ton, standard copper.

AVERAGE PRICE OF TIN AT NEW YORK

Month.	1907.	1908.	Month.	1907.	1908.
January	41.548	27.380	July	41.091	.....
February	42.102	28.978	August	37.667	.....
March	41.313	.....	September	36.689	.....
April	40.938	.....	October	32.620	.....
May	43.149	.....	November	30 833	.....
June	42.120	.....	December	27.925	.....
			Av. year.	38.166	.....

Prices are in cents per pound.

AVERAGE PRICE OF LEAD

Month.	New York.		London.	
	1907.	1908.	1907.	1908.
January	6.000	3.691	19.828	14.469
February	6.000	3.725	19.531	14.250
March	6.000	.....	19.703	.....
April	6.000	.....	19.975	.....
May	6.000	.....	19.688	.....
June	5.760	.....	20.188	.....
July	5.288	.....	20.350	.....
August	5.250	.....	19.063	.....
September	4.813	.....	19.775	.....
October	4.750	.....	18.531	.....
November	4.376	.....	17.281	.....
December	3.658	.....	14.500	.....
Year	5.325	.....	19.034	.....

New York, cents per pound. London, pounds sterling per long ton.

AVERAGE PRICE OF SPELTER

MONTH.	New York.		St. Louis.		London.	
	1907.	1908.	1907.	1908.	1907.	1908.
January	6.732	4.513	6.582	4.363	27.125	20.563
February	6.814	4.788	6.664	4.638	25.938	20.875
March	6.837	.....	6.687	.....	26.094	.....
April	6.685	.....	6.535	.....	25.900	.....
May	6.441	.....	6.291	.....	25.563	.....
June	6.419	.....	6.269	.....	25.469	.....
July	6.072	.....	5.922	.....	23.850	.....
August	5.701	.....	5.551	.....	21.969	.....
September	5.236	.....	5.086	.....	21.050	.....
October	5.430	.....	5.280	.....	21.781	.....
November	4.925	.....	4.775	.....	21.438	.....
December	4.254	.....	4.104	.....	20.075	.....
Year	5.962	.....	5.812	.....	23.771	.....

New York and St. Louis, cents per pound. London in pounds sterling per long ton.

The Engineering and Mining Journal

COAL MINING SUPPLEMENT

The Early History of Anthracite Mining

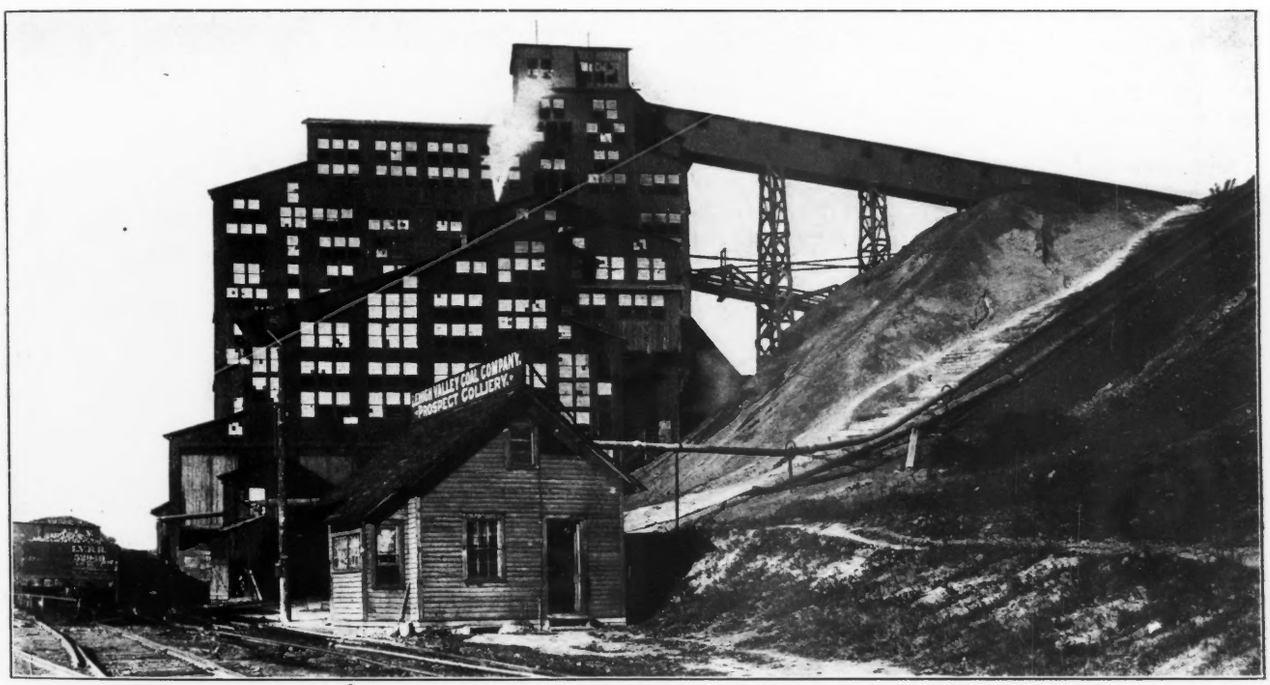
Before Jigs Were Introduced, 40 Per Cent. of the Total Coal Mined Was Thrown on the Culm Piles

BY H. H. LAWRENCE

The earliest discovery of anthracite coal in the United States dates back to either 1768 or 1769, when it was used to some extent by a blacksmith named Gore, in the Wyoming region. In 1749, a section of coal land, 125 miles long and 30 miles wide, extending from the Blue mountains on the south to the Susquehanna river on the west, and from Mahonoy creek on the north to the mouth of Lackawaxen creek on the east, comprising the entire Dauphin and Schuylkill counties and part of Northumberland, Columbia, Luzerne, Northampton, Monroe and Pike counties, was bought from the Indians by the Government for $2500. In 1774, coal land was sold in the vicinity of Scranton, Penn., for 4c. an acre. In 1762, about 200 colonists came from Connecticut and settled at Mill Creek a little above Wilkes-Barre, Penn. The land was then much appreciated so that it was sold for $2 to $3 an acre.

In 1768, Chas. Stewart made a survey of the Wyoming valley, and on his map the location of an outcrop of coal was noted at Edwardsville. In 1776, two Durham boats came to Wyoming to buy coal from R. Geer, who was operating a mine near Mill Creek, where the Prospect breaker of the Lehigh Valley Coal Company now stands. The fuel thus purchased was largely used in the manufacture of arms. In 1791 a hunter accidently discovered coal near Mauch Chunk. The earliest use of coal was by the blacksmiths who were able to use it in forging, but when it was tried in an ordinary open fireplace, the natural draft was insufficient to effect its combustion.

In 1803, about 200 tons of anthracite was marketed in Philadelphia, by the Lehigh Coal Mine Company, but it was pronounced worthless as no one knew how to burn it. Col. Geo. Shoemaker, in 1812, marketed in Philadelphia nine wagonloads of coal from the Schuylkill region. This was the first shipment of anthracite coal that was successfully burned with natural draft by manufacturers. This success was accidental. The workmen, tired of fanning and raking the fire, closed the doors and went to luncheon; when they returned, they were surprised to find a glowing fire in the furnace.



PROSPECT BREAKER OF LEHIGH VALLEY COAL COMPANY, LOCATED AT NORTH WILKES-BARRE, PENN.

In February, 1808, Judge Jesse Fell of Wilkes-Barre made an experiment at his hotel on the corner of North Washington and Northampton streets. At the conclusion of his experiment Judge Fell made the following memorandum: "Made experiment of burning the common stone-coal of the valley in a grate, in a common fireplace in my house, and find it will answer the purpose of fuel, making a clearer and better fire at less expense than burning wood in the common way. Feb. 11, 1808, Jesse Fell." The result of this experiment was to create a great in-

terest in the Wyoming valley, and people came from all parts of the State to witness further experiments which were made with an iron grate instead of the hickory grate first used. Soon there were a dozen iron grates in use in Wilkes-Barre.

Beginning of Actual Mining

The practical beginning of anthracite mining was in 1807 and the men who first engaged in this business were John and Abijah Smith of Plymouth, Penn. These men came from Derby, Conn., in 1805, and bought coal land and mined coal on a commercial scale. They shipped the first ark load of fuel to Columbia, Penn., in 1807. The following year, they shipped several ark loads to the same market, and masons were sent with the loads to construct fireplaces for the customers. The average price of the fuel at this time was $10 per ton.

In 1813, Geo. M. Hollenback commenced mining coal near Mill Creek and shipped two ark loads. Jos. Wright of Plymouth at this time produced two or three ark loads and placed it on the market. In the meantime, Jacob Cist and Chas. Miner were busy writing articles on the new fuel, for publication in New York, Philadelphia and Baltimore papers, and soon the public commenced to realize the value of anthracite coal. Chapman, in 1817, mentioned the means of transporting coal on the Lehigh river by building dams and creating artificial floods. This process of transportation was quite efficient until 1827. In 1829, a canal for the transportation of coal was opened from Mauch Chunk to Easton and from White Haven to Mauch Chunk in 1837.

In 1807, the total coal output of the Wyoming valley was 55 tons; 1808, 150 tons; 1809, 200 tons; 1810, 350 tons; 1815, 1,000 tons; 1820, 2,500 tons. In the meantime the mines in the Lehigh region were busy. In 1820 they produced 365 tons; 1823, 5500 tons; 1825, 28,390 tons. The Schuylkill region mined and shipped 6400 tons in 1825. The Lehigh Coal and Navigation Company was organized and commenced mining and shipping coal in 1820 from the Summit Hill region.

In the Hazleton region, coal was first discovered in 1826. The Delaware & Hudson Canal Company was organized and commenced its business of shipping coal from the Carbondale region in 1829. In 1832, the Little Schuylkill railroad commenced carrying coal from the Tamaqua region. This was the first coal shipped by rail. In 1837-38 the first shipments of coal were made from the Hazleton and Beaver Meadow regions, while the first shipments from Lykens valley and Buck mountain regions were made in 1839-40. The Philadelphia & Reading railroad began shipping coal in 1842; the Central railroad of New Jersey, in 1852; the Delaware, Lackawanna & Western railroad in 1854, and the Lehigh Valley in 1855.

Wasteful Methods of Operation

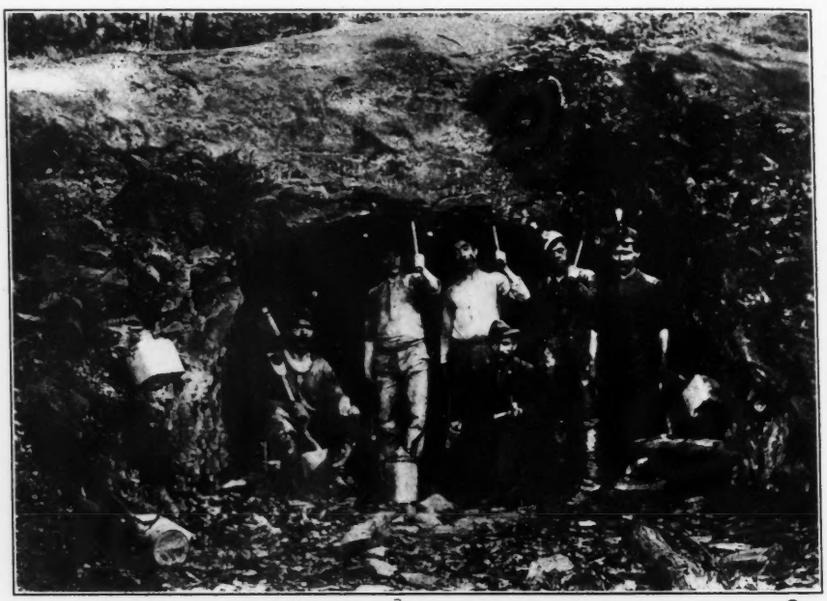
All the pioneer operators worked the seams by means of adits or drifts. They first developed the seams which gave them the greatest returns. They had little machinery, no hoisting engine and no pumps. The mine equipment consisted of a few cars, some wooden rails and ties, and horses or mules were the only source of power. Crude methods were used in mining, as most of the operators knew nothing about the business; consequently they ruined many of the richest seams and left them a constant source of danger to present miners. No records or maps of the workings were kept, and the mines were abandoned when the quantity of water increased so that further operations were impossible.

Up to 1836, the miners worked the seams by water-level drifts, but this method was soon abandoned and the sinking of shafts and slopes was resorted to. When the mines were worked below water level, a greater capital was required to develop them. Gradually the small individual operators were absorbed by the large companies. In the Schuylkill region, statistics show that in 1848, there were 120 individual operators working 111 mines above level. In 1853 there were 86 operators who had invested $2,500,000 in this region; but in 1870, practically three-fourths of all the mines in the field passed into the hands of the Reading railroad. The process of acquiring the coal lands by the large companies had also been going on in the middle and northern coal fields. Today more than 95 per cent. of the output is controlled by the large companies.

Simple Mechanical Devices Used

When anthracite mining was in its early stages, the simplest kind of devices were used for ventilating the workings. In the Lehigh region where the mines were comparatively deep, ventilation was effected by natural agencies. In the Wyoming valley in the sixties and early seventies, steam jets were generally used for ventilating purposes while in some mines a furnace was kept at the foot of the upcast.

On the morning of Sept. 6, 1869, the Avondale shaft, situated about four miles from Plymouth, was the scene of one of the greatest catastrophies in the history of coal mining in the United States. At this mine, the men had been out on strike for some time and on the morning in question had gone down for the first time since the settlement of the strike. The mine was equipped with only one shaft and the ventilation was effected by a furnace at the foot of this shaft; the fire in the furnace ignited the brattice and in a few minutes, the fire was beyond human control. The flames caught the breaker and engine room which were near the mouth of the shaft and 110 men and boys lost their lives. The excitement caused by this fire is indescribable, but one good resulted from the disaster, in that it awakened the Legislature of the State to enact laws enforcing proper ventilation and providing a second opening for all mines.



A DRIFT MOUTH AT THE BALTIMORE MINE

Early Preparation

One of the most important features in connection with the development of the early preparation of anthracite coal for market, was the introduction of machinery to separate slate and bone from coal. Since 1865 much time and attention has been devoted by mining engineers to the

perfection of machines that would meet the constantly increasing demands of the trade. Every year the amount of impurities permitted in marketable coal decreased, until in 1895 the inspection became so severe that the railroads refused to transport coal that was condemned by their inspectors and the operators were obliged to reprepare it by again passing it through the breaker, involving the same amount of labor and expense that it originally cost to prepare it, besides the breakage, which was at least 12 per cent.

The First Jig

In the early sixties it became evident that a machine was needed which would remove all the impurities from coal. Hezekiah Bradford, of Philadelphia, was perhaps the pioneer in introducing the jig in which he used a constant feed of stone to form a jigging bottom. At about the same time, Plum invented a drawgate jig; Clark, Stroh and Bradly followed with new devices. Most of these machines were based upon the reciprocating principle, while others had the material receptacle stationary, agitating the water by means of plungers. Before the introduction of the jig, all small coal which passed through a 7/8-in. square mesh was thrown on the culm pile. The coal thus dumped on culm piles amounted to 40 per cent. of the total shipments.

Stripping anthracite coal was first introduced by Pardee & Co., in 1874, at the Hollywood Colliery. The cost of removing the dirt and rock was then from 15 to 25c. per cu. yd. The stripping at this colliery continued until 1899. The total stripped area was over 40 acres. The average depth of the strata removed was 45 ft., and amounted in all to about 2,259,110 cu. yd. The percentage of the coal thus won was 98.3 per cent. of the original contents of the seam.

The inspection service of the Pennsylvania anthracite field dates back to the passage of the law of 1870, which was enacted immediately after the Avondale disaster and affected the whole field. Schuylkill county had previously passed a law of inspection on April 12, 1869. The first report of a mine inspector covered this county only and was for the year 1869.

Some Advancements

One of the notable advancements in the use of power was the introduction of electricity as a motive power. The old system of mule haulage has been in a large degree replaced by electric traction. One electric machine takes the place of at least 20 mules. Some of the old ventilating fans are now driven by electric motors, and lately the reciprocating type of pump has been supplemented by centrifugal and turbine machines driven by electric motors. Thus the unsatisfactory system of having underground steam pipes and exhaust steam has been largely eliminated.

The use of steel in mines in place of timber is a recent advancement in the anthracite field. The Susquehanna Coal Company at Nanticoke, Penn., was perhaps the pioneer in this line. The steel thus employed by them has been in use for some fifteen years, exposed constantly to the mine air and water, without showing signs of fracture or failure. The metal is protected by a good coat of paint, and beyond its long life, has other advantages as compared with wood.

To keep mines dry, many powerful engines work day and night. It has been estimated that in 1905 there were 633,000,000 gal. of water pumped from the mines every day. To deliver this quantity of water, nearly one thousand powerful pumps were used. The Heidelberg colliery of the Lehigh Valley Coal Company located at Smithsville, Penn., is one of the wettest mines in the field. The output of water from this colliery has been estimated to be 40 tons per ton of coal mined and hoisted. In this connection, the Lehigh Coal & Navigation Company has been constructing a large water drainage tunnel between Tamaqua and Mauch Chunk. This drainage system consists of the main tunnel, drainage gangways and connecting tunnels, making in all 24,000 ft. of tunnel and 54,000 ft. of gangway, or nearly 11 miles of drainage system. This elaborate work is estimated as costing $700,000 and is expected to effect a direct saving of $150,000 per year. The work was started about 20 months ago and will take several years to complete.

The coal almanac reproduced on the following page from an old copy, is historically interesting since it shows the anthracite coal trade in its early infancy.

MINERAL SPRING BREAKER AT PARSONS, PENN.

MINERS' JOURNAL COAL ALMANAC FOR 1857.

Table of the Weekly Shipments from the following points in 1856, which we publish for reference:

		Schuylkill R. R.	Schuylkill Canal	Lehigh R. R.	Lehigh Canal	Del. & Hud. Canal	Penn'a. Coal Co.
[illegible]							

SAFETY LAMPS.

B. Bannan has made arrangements to keep always on hand an assortment of the best Working *Safety Lamps*, made under the inspection of one of the Government Agents of England, according to the laws of that country, (which are very strict,) to secure the safety of the Miner. Also, Wire Gauze prepared for Safety Lamps, in accordance with the Laws of England. These Lamps and the Gauze, will be furnished at the lowest rates by the 100, dozen or single—and sent to every part of the country. Orders by mail promptly attended to.

On the 3d of January, 1856, the MINERS' JOURNAL entered on its THIRTY-THIRD VOLUME. It is the acknowledged organ of the Coal Trade of the United States, and particularly of the Anthracite Trade of Pennsylvania. All the Statistics of this great and growing Trade, found in the various publications of the day, have been taken from its columns, where they have been carefully compiled and originally promulgated. In fact, in its columns, the only complete record of the rise and progress of the Trade can be found. Although published in Schuylkill County, full, impartial and correct reports, as far as it is possible to procure them, of the progress and Trade of all the other Regions, are invariably found in its columns. Arrangements are in progress for receiving correct information from all the important points, together with the Foreign correspondence relating to European Mining, which we expect will be continued this year, together with the correct and reliable information always given of the state of the Trade, will make the JOURNAL absolutely necessary to every Operator, Dealer and large consumer of Coal—as the same epitome of Coal Statistical information cannot be obtained in any other publication of the day.

The JOURNAL aspires to the foremost rank, and no expense is spared in making it a First Class Newspaper. It will also be found an excellent *Family Paper*, moral in its tone, and every thing of an improper character and immoral tendency is carefully excluded from its columns.

Its general features may be summoned up as follows: *Independent on all subjects*—the advocate and defender of regular legitimate business, and a foe to all mere speculative objects—a warm advocate of the cause of Temperance and Prohibition—sympathising deeply with the leading Principles of Republicanism, and also with Americanism, so far as they are liberal and protective.

The circulation of the JOURNAL is equal to the united circulation of the four English Papers published in the County—and of course is a very desirable advertising medium. In Schuylkill and the adjoining Counties, it circulates among business men of all parties, and all classes of the community. Abroad it embraces more Capitalists, Manufacturers, Coal Dealers, and Iron Men, probably than any other paper published in the country.—It circulates in almost every State in the Union, and in Canada and Europe; and goes wherever there are dealers in Coal. To Manufacturers in general, Land Owners, Contractors, and those interested in Coal Lands and Iron Works, it presents unrivalled facilities for advertising.—

The MINERS' JOURNAL is published weekly on a large sheet, and is neatly printed. Subscription price $2 per annum, payable in advance. Subscriptions can be sent by mail from any part of the country, addressed to

BENJAMIN BANNAN,
Editor Miners' Journal, Pottsville, Pa.

A few copies of the JOURNAL can be sent from the beginning of the year. Copies of the Statistical number of the JOURNAL, published January 11, 1857, giving a full view of the whole trade, can also be furnished.—Price two postage stamps.

COUNTING-HOUSE ALMANAC. 1857.

1857.	SUNDAY	MONDAY	TUESDAY	WED.	THURS.	FRIDAY	SATUR.
Jan'y					1	2	3
	4	5	6	7	8	9	10
	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	31
Feb'y	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
March	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30	31				
April				1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30		
May						1	2
	3	4	5	6	7	8	9
	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	24	25	26	27	28	29	30
	31						
June		1	2	3	4	5	6
	7	8	9	10	11	12	13
	14	15	16	17	18	19	20
	21	22	23	24	25	26	27
	28	29	30				

1857.	SUNDAY	MONDAY	TUESDAY	WED.	THURS.	FRIDAY	SATUR.
July				1	2	3	4
	5	6	7	8	9	10	11
	12	13	14	15	16	17	18
	19	20	21	22	23	24	25
	26	27	28	29	30	31	
August							1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23	24	25	26	27	28	29
	30	31					
Sep't			1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30			
Oct.					1	2	3
	4	5	6	7	8	9	10
	11	12	13	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	31
Nov.	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26	27	28
	29	30					
Dec.			1	2	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31		

LENGTH AND GRADES

Of the Principal Coal and Transporting Lines, from the Anthracite Regions of Pennsylvania, to Philadelphia and New York. Also the length of Canals leading to same points:

Philadelphia & Reading Railroad.

From Mount Carbon to Richmond,	93½
" thence to New Brunswick, by river and canal,	60
" thence to New York, by river and bay,	33
Total,	186½

The grades on this road are all level, and slightly descending with the Trade, except about 1½ miles, between the Schuylkill and the Delaware, which is 28 feet to the mile ascending.

Schuylkill Navigation.

From Mount Carbon to Philadelphia, lockage 620 feet,	108½
" Philadelphia to New York, by Delaware & Raritan Canal and river and bay,	130½
Navigation total,	238½

Lehigh Navigation & Del. Division.

From White Haven to Mauch Chunk, lockage 600 feet,	28
" Mauch Chunk to Easton, lockage 323 feet,	46½
" thence to Bristol,	60½
" Bristol to New York,	87
From Mauch Chunk, 193½—from White Haven,	218

The Lehigh and Susquehanna Railroad, a feeder to the Lehigh Canal is 20 miles long, with three inclined planes ascending from the Wyoming Valley, and 64 feet grade descending to the Lehigh—making 238½ miles from Wilkesbarre, via Lehigh Navigation, to New York.

From Mauch Chunk to Philadelphia, by way of Lehigh and Delaware Canal,	106½
River Navigation,	31
Total,	137½

Delaware and Hudson Canal.

From Carbondale to Honesdale, by rail, with 14 inclined planes, overcoming an elevation of about 1100 feet, worked by gravity and stationary engines,	13½
" Honesdale to Rondout by canal, lockage 1250 feet,	108½
" Rondout to New York, by river,	86½
Total,	208½

Pennsylvania Coal Company's Route

From Pittston to Hawley, by rail, with 32 planes, overcoming an elevation of about 1250 feet, and worked by gravity and stationary engines,	50
" Hawley to Rondout, by Delaware and Hudson Canal,	100
" thence to New York, by river navigation,	85½
Total,	235½

By Lehigh Valley and Belvidere and Delaware Railroads.

	miles.
From Mauch Chunk to Easton, grades descending from 23 to 60 feet per mile,	50
From thence to Trenton, grades descending 6 ft. to a mile,	18
" " to N. Brunswick by Canal,	27½
" " to New York by River and Bay,	34
Total—break of guage at Easton,	186½

Lehigh Valley and New Jersey Central Railroads.

From Mauch Chunk to Easton, (Lehigh Valley R. R.) descending and level,	46½
" thence to Elizabethport, grades ascending 22, descending 40,	62½
From thence to N. York by Bay Navigation,	12
Total,	121½

Roads Connecting with the Above.

From Beaver Meadow to Mauch Chunk, grades descending from 60 to 120,	30
From Hazleton to Mauch Chunk, grades descending from 80 to 120, about	22

Proposed Connections with Lehigh Valley.

From Tamaqua to Weissport, grade descending 30 feet to a mile,	27
From thence to Easton, via. Lehigh Valley,	41½
" " to N. York via. N. J. Central & N. Y. Bay,	75½
Total,	134½

Delaware, Lackawanna and Western Roads.

From Scranton to N. Hampton, grades ascending from [illegible] to 75, descending from 60 to 77,	83½
From New Hampton to Elizabethport over New Jersey Central,	47½
From thence to New York,	12
Total,	143½

Proposed Connections with the New Jersey Central.

From Mt. Carbon to Auburn—grades descending,	[illegible]
" thence to Allentown, grades descending 52, ascending 12,	38
From thence to Easton via. Lehigh Valley,	16½
" " to Elizabethport, via. N. J. Central,	62½
" " to New York,	12
Total,	129½

Northern Central R. R. to Baltimore

Sunbury to Baltimore,	138 miles
Terminus Trevorton R. R., to Baltimore,	1[illegible] "
From Trevorton to Baltimore,	161 "
Terminus Lykens Valley R. R.,	113 "
From Pinegrove to Baltimore,	1[illegible] "

Broad Top Railroad.

From Broad Top to Huntingdon,	30 miles
From Huntingdon to Philad'a—Canal & R. R.,	200 "
From Huntingdon to Baltimore, by R. R.,	178 "
Total distance to Philadelphia, 230—Do. to Baltimore,	208

Baltimore & Ohio Railroad.

From Cumberland to Baltimore—Railroad,	178 miles
From Piedmont to Baltimore—Railroad,	206 "
Cumberland to Philadelphia,	311 "
Cumberland to New York,	425 "
By Chesapeake & Ohio Canal to tide at Alexandria,	186 "

Freights, &c.

Cumberland to Baltimore, by Railroad,	$2 75
Piedmont to Baltimore, by Railroad,	3 15
(Less 25 cents for Baltimore City consumption.)	
By Canal to tide at Alexandria, (freight only,)	1 50
Freight from Baltimore to New York,	2 00

Road undulating with heavy grades at some points.

Ultimate Capacity of Coal Transporting Railroads,

With various grades and the actual cost of transportation upon level and adverse grades when supplied to their full, half, or quarter capacities, as deduced from the cost and experience of working the Reading Rail Road, by its Engineer, J. Dutton Steel, Esq. The experience of the Philadelphia and Reading Railroad, with its enormous tonnage, is considered the best data that can be obtained.

Level Roads—Average net load, 437.2 tons.

	Tons.	No. of Trains.		Per Mile.
Capacity,	4,000,000	9,160	Cost per ton,	.00 cents.
½ do	2,000,000	4,574	" "	.09 "
¼ do	1,000,000	2,287	" "	.16 "

Grades of 32 feet per mile—net load, 233.3 tons.

	Tons.	No. of Trains.		Per Mile.
Capacity,	2,112,440	9,160	" "	.[illegible] "
½ do	1,056,[illegible]	4,574	" "	.92 "
¼ do	528,[illegible]	2,287	" "	1.[illegible] "

Grades of 25 feet per mile—net load, 208.7 tons.

	Tons.	No. of Trains.		Per Mile.
Capacity,	1,[illegible]	9,160	" "	.92 "
½ do	940,[illegible]	4,574	" "	.99 "
¼ do	470,[illegible]	2,287	" "	1.13 "

Grades of 53 feet per mile, net loads, 128.6 tons.

	Tons.	No. of Trains.		Per Mile.
Capacity,	1,[illegible]	9,160	" "	1.[illegible] "
½ do	[illegible]	4,574	" "	1.[illegible] "
¼ do	294,[illegible]	2,287	" "	1.64 "

Grades of 55 feet per mile, net loads, 119.1 tons.

	Tons.	No. of Trains.		Per Mile.
Capacity,	1,0[illegible]	9,160	" "	1.[illegible] "
½ do	544,[illegible]	4,574	" "	1.30 "
¼ do	272,411	2,287	" "	1.73 "

In applying these figures to the several routes, I shall assume that the cost of water transportation by the Delaware and Raritan Canal is 4-10, and by river navigation 3-10 of a cent per ton per mile. Charging those roads, which have a change of motive power, with 15 cents per ton as an equivalent to that inconvenience, and considering them all working to ½ capacity.

The above charges for transportation on the canal do not include repairs or lock tending, whilst the railroad charges cover all expenses except interest on capital.

With this data any person may apply the cost of Rail Road and River and Canal navigation on the different grades of Roads and Canals.

ANTHRACITE COAL TRADE OF THE UNITED STATES.

The following Table exhibits the quantity of Anthracite Coal sent to Market from the different Regions in Pennsylvania, from the commencement of the Trade, in 1820, to 1856, inclusive; to which is appended the Semi-Anthracite Trade, the Cumberland Bituminous Trade, the Importations of Foreign Coal, and the Exportation of Domestic Coal.

Yrs.	Schuylkill: Canal.	Railroad.	Total.	Pine-grove.	Little Sch'kill.	Lehigh: Canal.	Railroad.	Total.	Wyoming Region: By Lehigh R. Road.	Del. & Hud. Coal Co.	Penna. Coal Co.	By Canal.	N. West'n R. Road.	Total.	Shamokin.	Aggregate.	Annual Increase.	Semi Anthracite and Bituminous: Lykens Valley.	Short Mountain.	Dauph'n Co.	Trevorton.	Broad Top.	Aggregate.	Cumberland.	Import of For'n Coal.	Increase and Decrease.	Aggregate of all Kinds.	Total Increase of all Kinds.	Exportation of Domestic Coal.
1820–1856	[illegible]																												

ANTHRACITE COAL TRADE OF the United States for 1856.

[illegible]

Lateral Railroads.

The Official quantity of Coal transported over the different lateral Railroads in Schuylkill Co. in 1856:

[illegible]

Exportation of Domestic Coal.

The exportation of domestic Coal is rapidly on the increase. In 1846 the whole quantity was only 6,300 tons.

	Tons.	Value.
[illegible]		

WEST BRANCH TRADE, 1856.

[illegible]

SWATARA TRADE, 1856.

[illegible]

LORBERRY CREEK COAL TRADE, 1856.

[illegible]

MT. CARBON TRADE, 1856.

[illegible]

SCHUYLKILL VALLEY TRADE.

[illegible]

ASHLAND TRADE, 1856.

[illegible]

MILL CREEK TRADE, 1856.

[illegible]

LEHIGH TRADE, 1856.

[illegible]

BY LEHIGH VALLEY RAILROAD.

[illegible]

WYOMING TRADE, 1856.

[illegible]

LITTLE SCHUYLKILL TRADE, 1856.

[illegible]

SHAMOKIN TRADE, 1856.

[illegible]

Dauphin & Susquehanna Railroad Transportation of Coal in 1856.

[illegible]

COAL OPERATORS.

The following is the aggregate quantity of Coal shipped by each Operator during the year 1856 from the Schuylkill Region:

[illegible]

* From Bound Brook, on New Jersey Central, to Perth Amboy, a Road now making, is 12 miles, and avoids one of the Summits leading to Elizabethport, and would make the distance from Easton to Perth Amboy 52 miles only.

☞ A copy of this Coal Almanac is furnished to all new subscribers to the *Journal*. Every Coal Dealer, and large consumer of Coal, ought to take a copy of the *Journal*, as the $2 a year may be the means of saving hundreds of dollars annually from the information derived from its columns in regard to the state of the trade.

☞ REFERENCES.—D. stands for Drift—Sl. for Slope—S. for Shaft—W. for white Ash Coal, and R. for Red Ash Coal.

Single Copies of this Almanac 25 Cents, or Eight 3 Cent Postage Stamps.

The Future Supply of Anthracite Coal

After Mining 1,561,000,000 Tons of Anthracite Coal, About 13,000,000,000 Tons Remain. We May Obtain 40 Per Cent.

BY RICHARD LEE

The amount of anthracite coal now remaining underground is a frequent topic in the magazines and newspapers of the United States, particularly in those of northeastern Pennsylvania. Predictions of exhaustion have been made by various authorities who show that the life of the anthracite industry ranges from 75 to 200 years. The uncertainty in these estimates rests entirely upon various unknown quantities, among them being the future rate of consumption, the changing methods of mining and preparing coal and the utilization of the waste.

Decline In Production Will be Gradual

In the last 50 years production has increased enormously. The output for each decade is nearly double that of the preceding period. If this rate of increase is to continue uninterrupted until the last ton of coal is mined, exhaustion might come within the next 25 years. But in the natural order of mining, such an occurrence is an impossibility, for the obvious reason that the decline in production will come gradually.

In making an estimate, we must investigate the waste incident to the utilization and mining of coal. The loss of fuel in the form of waste is prodigious. Take for instance the railways of the United States which use annually 150,000,000 tons of coal, of which only 7,500,000 tons are actually converted into power for drawing the trains, the remaining 142,500,000 tons are utterly lost. Fifty million tons of anthracite coal are used annually in the homes of our land, but only 1,000,000 tons are actually utilized in heating and cooking. These are, perhaps, the most striking examples of the conditions prevailing at the present time. Yet in the face of the facts, coal is mined as if there was an inexhaustable supply. When facing this enormous waste, the question naturally arises, how long will the supply last? This is a particularly pertinent question as regards the anthracite coal of Pennsylvania, which amounted to 17.2 per cent. of the total production of coal in the United States in 1906. The area underlaid with anthracite coal is limited.

The Total Anthracite Coal Area

According to the Geological Survey of Pennsylvania, there are 483 square miles (309,120 acres) of coal area. This area is divided into three great groups, known as the Southern, Middle and Northern fields.

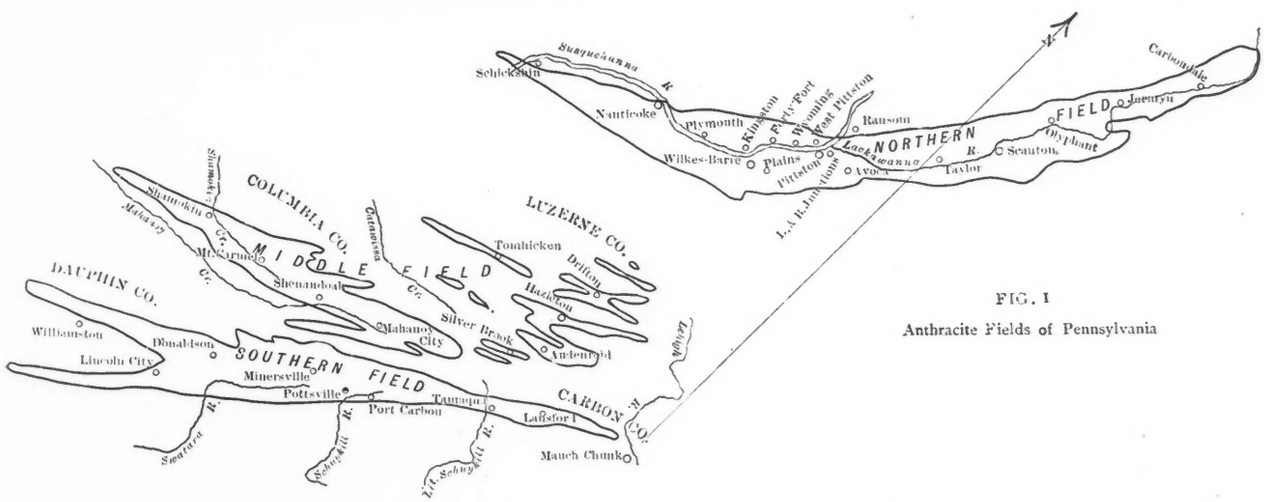


FIG. 1
Anthracite Fields of Pennsylvania

The area of the Southern coalfield is approximately 89,600 acres. It lies in Dauphin, Schuylkill and Carbon counties. The maximum length of the field is 55 miles and the greatest width is over 4 miles at Pottsville. The eastern portion of this area forms the Panther Creek basin which extends in a westerly direction from Mt. Pisgah, to the Little Schuylkill river. The width of the coal measures gradually increases from Mt. Pisgah where the field is only a few hundred feet wide, to 4 miles at Pottsville, where the coal measures are better known as the Pottsville basin. The southern extremity of the measures split up into two parts and is often known under the name of the "Fish-tail." The northern portion of this area forms the Bear Creek basin, the length of which is about 13½ miles, and the width, 1½ miles. This basin terminates at Wiconesco. The southern portion of the "Fish-tail" is known as the Dauphin county basin, the length of which is 22 miles. In this district lie the famous Lykens valley formations. (See illustration.)

The middle anthracite field is divided into two districts, the Upper Lehigh and the Schuylkill regions which embrace 83,200 acres underlaid with coal. The eastern portion of this field embraces Beaver Meadows, and the long and narrow Hazleton and Black Creek basins which lie nearly parallel to each other in a southwesterly direction. The Beaver Meadows basin is 15 miles long, its greatest width is 1½ miles. The Black Creek basin is nearly 7 miles long and the Hazleton basin is 13 miles long. The Schuylkill region contains six basins, which are divided into two groups. The southern portion of the area from Locust valley to Ashland is known as the Mahonoy group, while to the north lies the Shamokin group which is over 40 miles long and extends from Treverton to the head of the Catawissa valley.

The northern coalfield lies in Susquehanna, Lackawanna and Luzerne counties. This coal area is 50 miles long and its maximum width is about 5½ miles. It contains approximately 128,000 acres. The northern extremity of this field is situated in Susquehanna county. The middle portion lies in Lackawanna county, while the southern or Wyoming valley is in Luzerne county. This coalfield has the same geographical features as the southern and middle fields. Its length is nearly proportional to its width. In this field we find a variable thickness in the coal measures which run from 300 ft. at Carbondale to 900 ft. at Wilkes-Barre and 1200 ft. at Nanticoke. At Tamaqua there is a thickness of over

2000 ft. and at Pottsville 3300 ft.; thus the carboniferous formations vary according to the locality. In the same manner the richness of the beds also varies. At Carbondale we find only 12 ft. of coal that can be mined, at Wilkes-Barre the workable thickness increases to 65 ft. At Tamaqua 120 ft. is the workable thickness; in the western middle field, 115 ft. and at Pottsville there is a total thicknessof 150 ft. of workable coal. The thickness of the Mammoth seam, a short distance from Tamaqua, is 115 ft., while the same bed in the Wyoming field is only 6 to 14 ft. thick.

Faults Are Numerous

The majority of the basins are in the form of large troughs. In the Lackawanna the Susquehanna valleys, the seams lie practically flat on either side of the Lackawanna and Susquehanna rivers, and pitching seams are only found on the sides of mountains. In these flat coal measures, anticlinals, synclinals and faults are quite numerous, consequently the floors of the seams are extremely undulating and often twisted, which makes mining operations difficult and expensive.

The coal measures consist of micaceous sandstone, shales, fire clay and various kinds of slate uniformly distributed in the valleys. One characteristic feature of the coal measures is that these strata are underlaid with the Pottsville conglomerate. This conglomerate is hard and tough and is found on the mountains inclosing the coal area. The preservation of the present anthracite field is due to this hard stratum which has resisted the disruptive action of nature that has been eroding and gnawing away ever since the early formation of the carboniferous measures.

There is clear evidence that the Wyoming and Lackawanna basins were once the beds of great rivers. At Pittston, we find sand hills and other alluvial deposits throughout the valleys. The thickness of this loose stratum varies in different localities. It runs from a few feet on the mountain sides to 175 ft. in the center of the valley. So that mining operation especially in shallow seams is most difficult.

Unprofitable to Mine Seams Less Than 3 Feet Thick

In mining the surface seams at present, much care is exercised to protect the lives of the workmen and property. The underground workings are not extended until the exact thickness of the loose deposit and rock overlying the seam is determined by test holes and diamond drills. In some localities the minimum thickness of this rock which overlies the seam and supports the wash is fixed at 50 ft., while in others it is 75 ft. or over. It is therefore obvious that those seams having a thickness of roof rock less than 50 ft. are considered as either unworkable or lost. The coal thus wasted in the northern districts is conservatively estimated at 15 per cent. of the total fuel in this field. Seams less than 3 ft. thick cannot be mined with profit at the present market price of coal; but in some localities, a bed as thin as 30 in. is often mined at the expense of the thicker seams. The thickness of the bed is a matter of locality. At one colliery a seam may be mined with a marginal return, while in an adjoining mine it is entirely too thin and is therefore unmineable. Such cases are quite numerous.

In the southern and middle fields the conditions are somewhat different from those of the northern field. One of the characteristics of these measures is that the seams are highly inclined. The total workable thickness of coal is greater in these districts than in the northern field. In mining coal in the southern and middle fields, the underground separation of impurities such as bone and slate bands is practically impossible on account of the highly inclined nature of the measures, so that the coal and its refuse are loaded out together and then separated in the breaker; in the northern field the first separation of the refuse is effected in the mines; the refuse is thrown to one side of the workings and packed there as "gob." There is a variety of bone, the fuel value of which entirely depends on the amount of earthy matter it contains. This waste material may be utilized as fuel as it is highly carbonized.

Economical Utilization of Fuel

In connection with the economical utilization of fuel, the operators and consumers of bituminous coals and lignite of the Western States have been greatly benefited by the results obtained by the Geological Survey Coal Testing Plant, at St. Louis, Mo. The value of the results obtained from the tests there made cannot be measured in dollars and cents. A few practical tests were made on bone from West Virginia. This bone is practically waste matter, as in the anthracite field. According to data presented before the Coal Mining Institute of America, by E. W. Parker, some of the samples treated contained 28.08 and 43.75 per cent. of ash; they were gassified in the gas producer. The results show that, in the first sample 1.48 lb. were consumed per electrical horse-power developed at the switchboard; and in the second example, 1.95 lb. were used. This data is extremely important and interesting as the efficiency of this bone was shown to be equal to that of Indiana or Illinois coal, which commands a market price of from $1.50 to $2.50 per ton. If similar tests were made on anthracite bone, I have not the least doubt that similar and startling results would be obtained. In Fig. 2 the lower horizontal line is the percentage of coal in the bone, while the upper horizontal line is the percentage of ash; the vertical line represents the specific gravity of the specimen. For example take a bone having a specific gravity of 1.66 on the "coal line." We find that it contains 77.5 per cent. coal, or on the "ash line," it contains 30.1 per cent. of ash. Take another example of bone (sp. gr. 1.80), on the "coal line," we find it contains 57.8 per cent. of coal, or on the "ash line" 48 per cent. ash. Now if we compare the average grade of anthracite bone with that of West Virginia (43.74 per cent. of ash), which is equal to Indiana or Illinois coal,

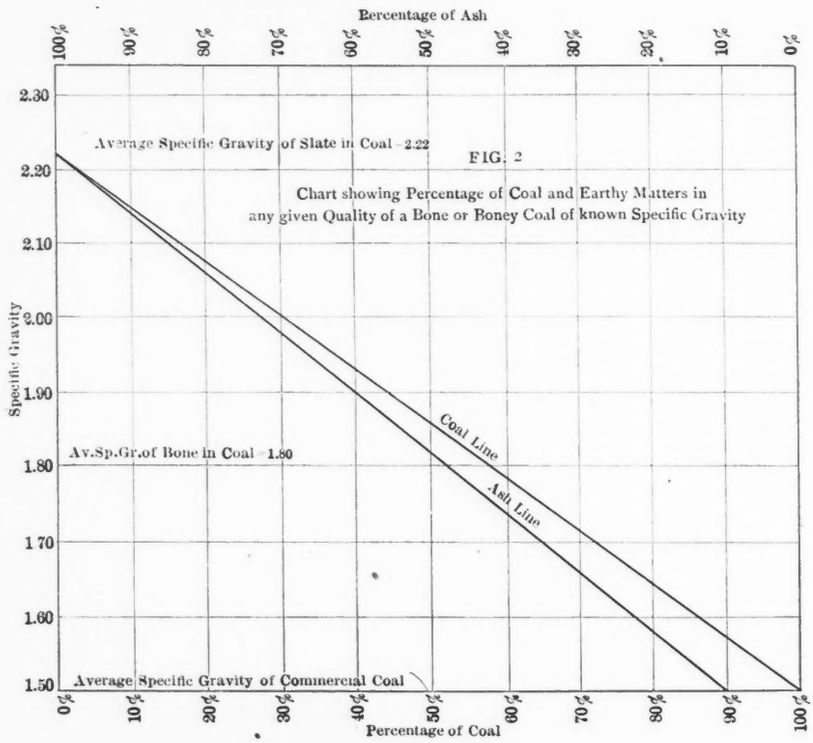


FIG. 2

Chart showing Percentage of Coal and Earthy Matters in any given Quality of a Bone or Boney Coal of known Specific Gravity

we will have some idea of the value of anthracite bone now being wasted and buried in the rock dumps.

One-third of Production Sent to Culm Banks

In the early development of anthracite mining the waste in the form of culm resulting from the preparation of the fuel was appalling, according to the report of the coal waste commission which made a thorough investigation of the subject in 1893. The following are some of the culm banks investigated:

	Coal Shipped. Tons.	Weight of Culm Bank. Tons.	Per cent of Bank.	Fuel Percent. of Bank.
Hammond Colliery	4,403,707	2,057,833	46.75	67.00
Lawrence (Jan, 1890) Colliery	1,852,000	a978 000	52.80	46.01
Stanton " "	1,163,000	a860,000	73.95	58.00
Draper " "	2,194,000	a1,000,000	45.58	50.00
Gilberton " "	1,750,000	a1,000,000	58.32	50.00

From these figures it is evident that the fuel thrown into the waste culm banks amounted to about 30 per cent. of the total coal shipments up to 1890.

Estimates of Original Tonnage

According to the Geological Survey of Pennsylvania, prior to mining operations, the anthracite coal originally in the ground amounted to about 19,500,000,000 long tons in the three fields; taking an average of 40 per cent. as an available supply, this would leave 7,800,000,000 tons as the initial supply. Since 1820 (360 tons were then mined) to the close of 1906, the total tonnage mined amounted to 1,561,343,839, which would leave 6,238,656,161 tons still available.

J. S. Harris, in the *Forum*, estimated that there were originally in the ground 14,453,397,600 cu.yd., which is equivalent in round figures to 16,766,000,000 tons.

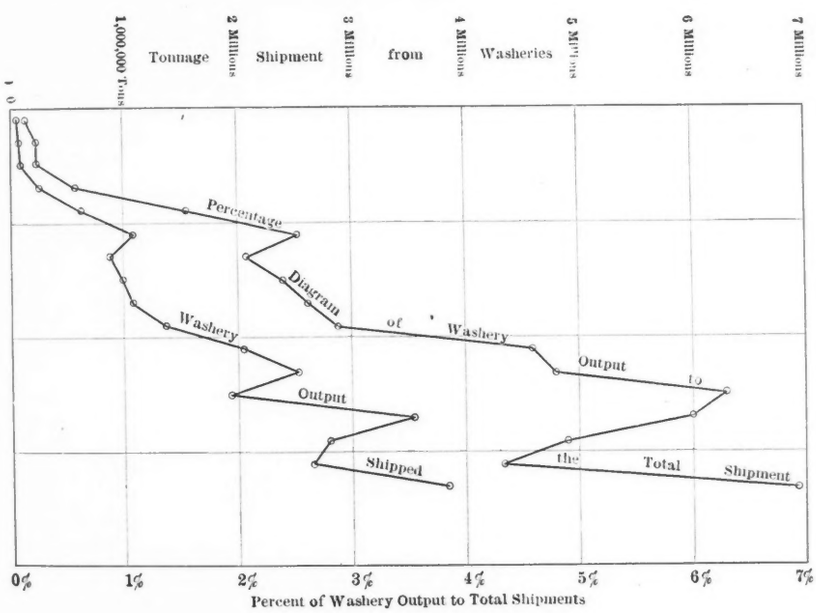


FIG. 3. DIAGRAM OF WASHERY OUTPUT

Since 1890, various kinds of washing machinery have been installed at many of the collieries, besides the washeries that have been erected in different localities; many grades of small sizes of coal are now reclaimed and shipped to market. In Table 2, we find the coal thus recovered amounted to 41,800 tons or 0.11 per cent. of the total shipments of the fuel for the same year. The production from this source has been gradually increasing. In 1906 it amounted to 3,846,500 tons, or 6.91 per cent. of the total shipments for the year. The coal waste commission estimated that the fuel sent to the culm piles prior to 1890 was 35 per cent. of the total production, or 315,700,000 tons. The coal now sent to the culm banks is much less than formerly and the future supply of coal will be consequently increased.

By again taking 40 per cent. as the percentage obtainable we have 6,706,400,000 tons as the initial available supply. By deducting the total amount thus mined, viz., 1,561,343,839 tons, we would have 5,145,056,161 tons Jan. 1, 1907.

A. D. W. Smith, one of the commissioners of the coal waste investigation, estimated the available supply of anthracite in 1892 yet to be mined, at 6,898,000,000 tons. Since then 749,469,955 tons have been mined leaving 6,148,530,045 tons yet to be mined.

In 1896 W. Griffith estimated the coal yet to be mined at 5,073,786,000 tons. Since then 704,738,740 tons have been mined, leaving 4,369,047,260 tons yet to be mined. The following table shows the relative quantity of coal yet to be mined:

	Tons.	Years.
Penn. Geo. Survey	7,800,000,000	390
J. Harris	5,145,056,161	257½
A. D. W. Smith	6,148,530,045	307⅜
W. Griffith	4,369,047,260	218½
Average	5 865,658,264	293¼

The present high tonnage cannot be maintained until the last ton of coal is mined out. When the period of decline sets in, the annual output will gradually decrease. By taking the average annual production since 1820 to 1906, we have a production of 18,155,156 tons per year. On the basis of the above yearly production, or say 20,000,000 tons, the life of the anthracite industry will vary from 218½ to 390 years. The average estimated life is 293¼ years. Now if we divide the declining period into two epochs, first the productive, second, the unproductive epoch, and supposing that the average annual output during the productive period is 30,000,000 tons, while 15,000,000 tons is the output of the unproductive epoch, the whole period will then be 293 years.

If x = the productive epoch, then
293 — x = unproductive epoch:
So that 30 x + 15 (293 — x) = 5865.
Therefore x = 98 years, the productive epoch, while
293 — x = 195 years, the unproductive epoch.

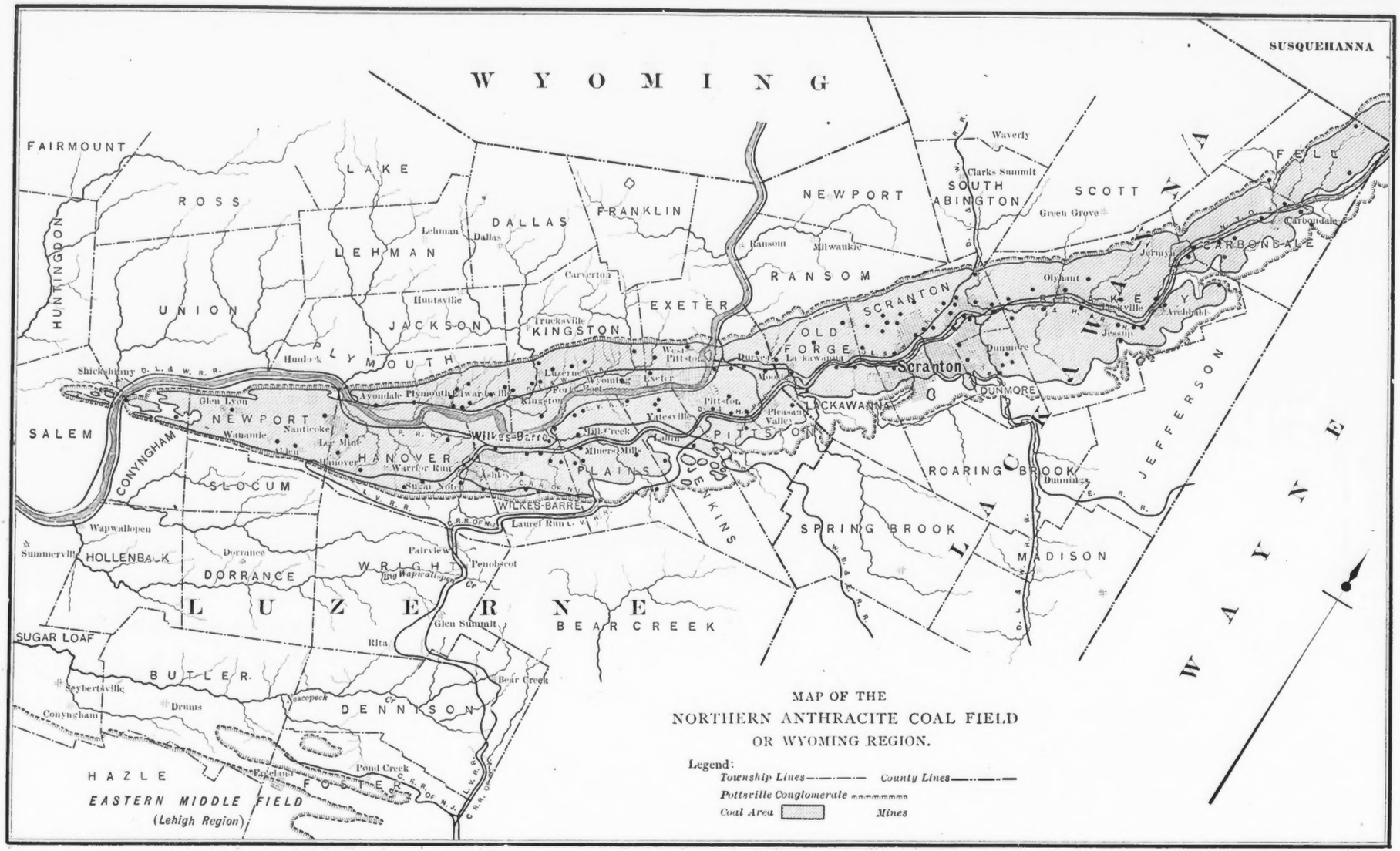
In other words, if the present production is the zenith, the average annual production for the next 98 years will be 30,000,000 tons, while the remaining 195 years will show an average annual production of 15,000,000 tons.

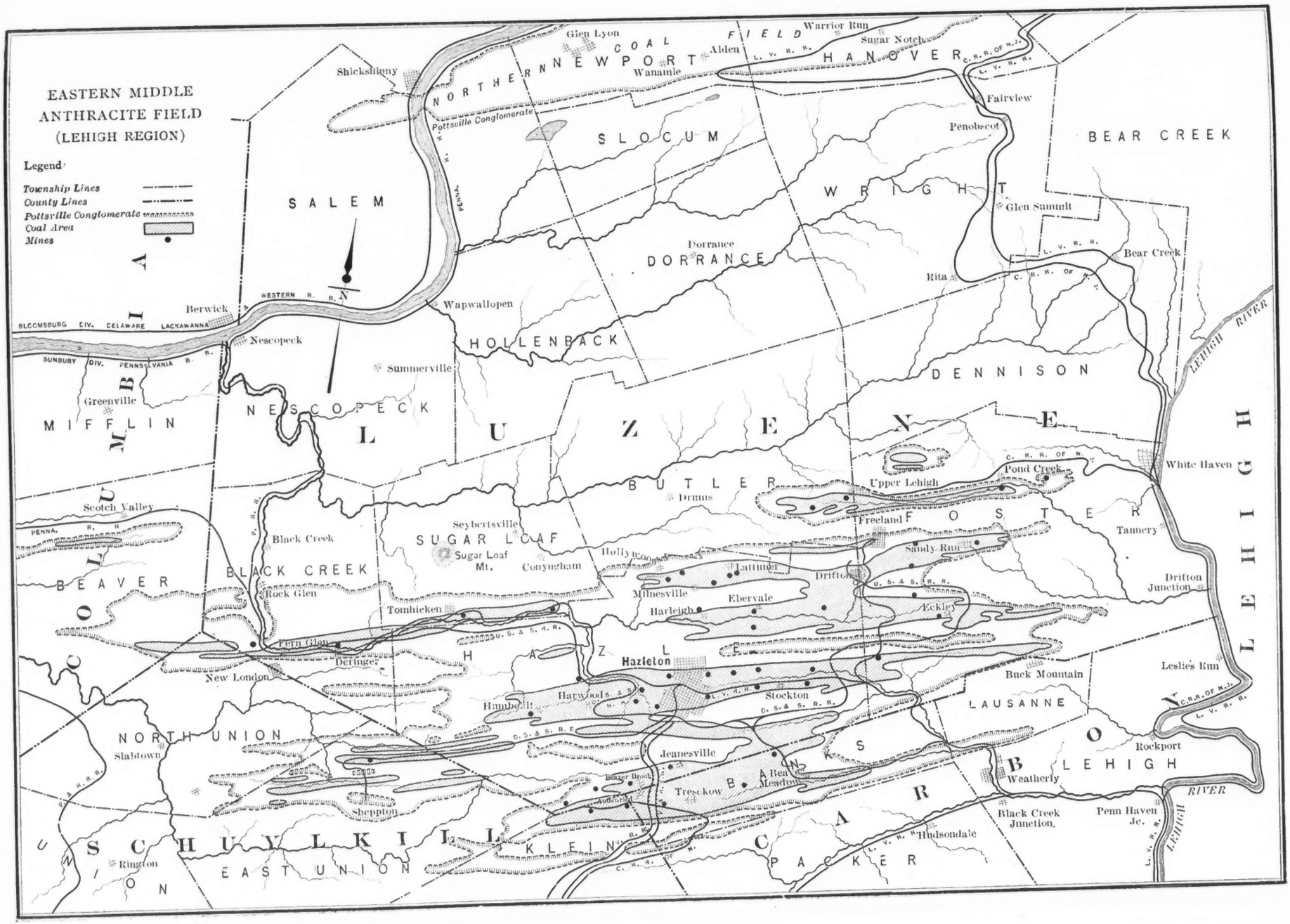
TABLE II. SHOWING RECLAIMED COAL TONNAGE FROM OLD CULM DUMPS

Year.	Shipment from Washeries.	Percent. of Washery Output to Total Shipments.
1890	41,800	0.11
1891	85,702	0.21
1892	90,495	0.22
1893	245,575	0.57
1894	634,116	1.53
1895	1,080,800	2.52
1896	895,042	2.07
1897	993,603	2.39
1898	1,099,019	2.62
1899	1,368,275	2.87
1900	2,059,309	4.57
1901	2,567,355	4.79
1902	1,959,466	6.28
1903	3,563,269	6.00
1904	2,800,466	4.87
1905	2,644,045	4.31
1906	3,846,501	6.91

Compressed Air vs. Electricity in England

Last year coal was mined in 3295 mines in Great Britain, as against 3461 in 1902. The number of coal-cutting machines at work was 1136, as against 483 the preceding year, a gain during this period of 653 cutters. It is apparent that machines are rapidly growing in favor. The motive power is still a debatable point in Scotland; electricity is the favorite, 171 machines being driven by electricity and 134 by compressed air. In England compressed air is the favorite, in one district the disparity being as great as 158 compressed-air machines to 94 driven by electricity. The machine-mined coal in 1906 was 10,202,506 tons. One ton in every 25 was mined by machinery.


WYOMING
SUSQUEHANNA
WAYNE
FAIRMOUNT
ROSS
LAKE
HUNTINGDON
LEHMAN
DALLAS
FRANKLIN
NEWPORT
SOUTH ABINGTON
SCOTT
GREENFIELD
CARBONDALE
RANSOM
UNION
JACKSON
EXETER
KINGSTON
OLD FORGE
SCRANTON
DUNMORE
PLYMOUTH
NEWPORT
SALEM
CONYNGHAM
HANOVER
PLAINS
PITTSTON
LACKAWANNA
JEFFERSON
SLOCUM
WILKES-BARRE
ROARING BROOK
HOLLENBACK
DORRANCE
WRIGHT
LUZERNE
SPRING BROOK
MADISON
BEAR CREEK
SUGAR LOAF
BUTLER
DENNISON
HAZLE
FOSTER
EASTERN MIDDLE FIELD
(Lehigh Region)
Waverly
Clarks Summit
Green Grove
Carbondale
Olyphant
Jermyn
Archbald
Jessup
Dunmore
Ransom
Milwaukie
Carverton
Huntsville
Trucksville
Luzerne
West Pittston
Pittston
Duryea
Mooretown
Exeter
Wyoming
Port Bowkley
Kingston
Ayondale
Plymouth
Edwardsville
Shickshinny
Glen Lyon
Nanticoke
Wanamie
Le Munt
Hanover
Warrior Run
Ashley
Sugar Notch
Yatesville
Mill Creek
Miners Mills
Pleasant Valley
Laflin
Wapwallopen
Summerville
Dorrance
Fairview
Penobscot
Big Wapwallopen Cr.
Glen Summit
Rita
Bear Creek
Seybertsville
Drums
Conyngham
Peacepack Cr.
Pond Creek
Freeland
Dunmore
Laurel Run
MAP OF THE
NORTHERN ANTHRACITE COAL FIELD
OR WYOMING REGION.
Legend:
Township Lines
County Lines
Pottsville Conglomerate
Coal Area
Mines


EASTERN MIDDLE
ANTHRACITE FIELD
(LEHIGH REGION)
Legend:
Township Lines
County Lines
Pottsville Conglomerate
Coal Area
Mines
NORTHERN COAL FIELD
NEWPORT
HANOVER
SLOCUM
WRIGHT
BEAR CREEK
SALEM
DORRANCE
HOLLENBACK
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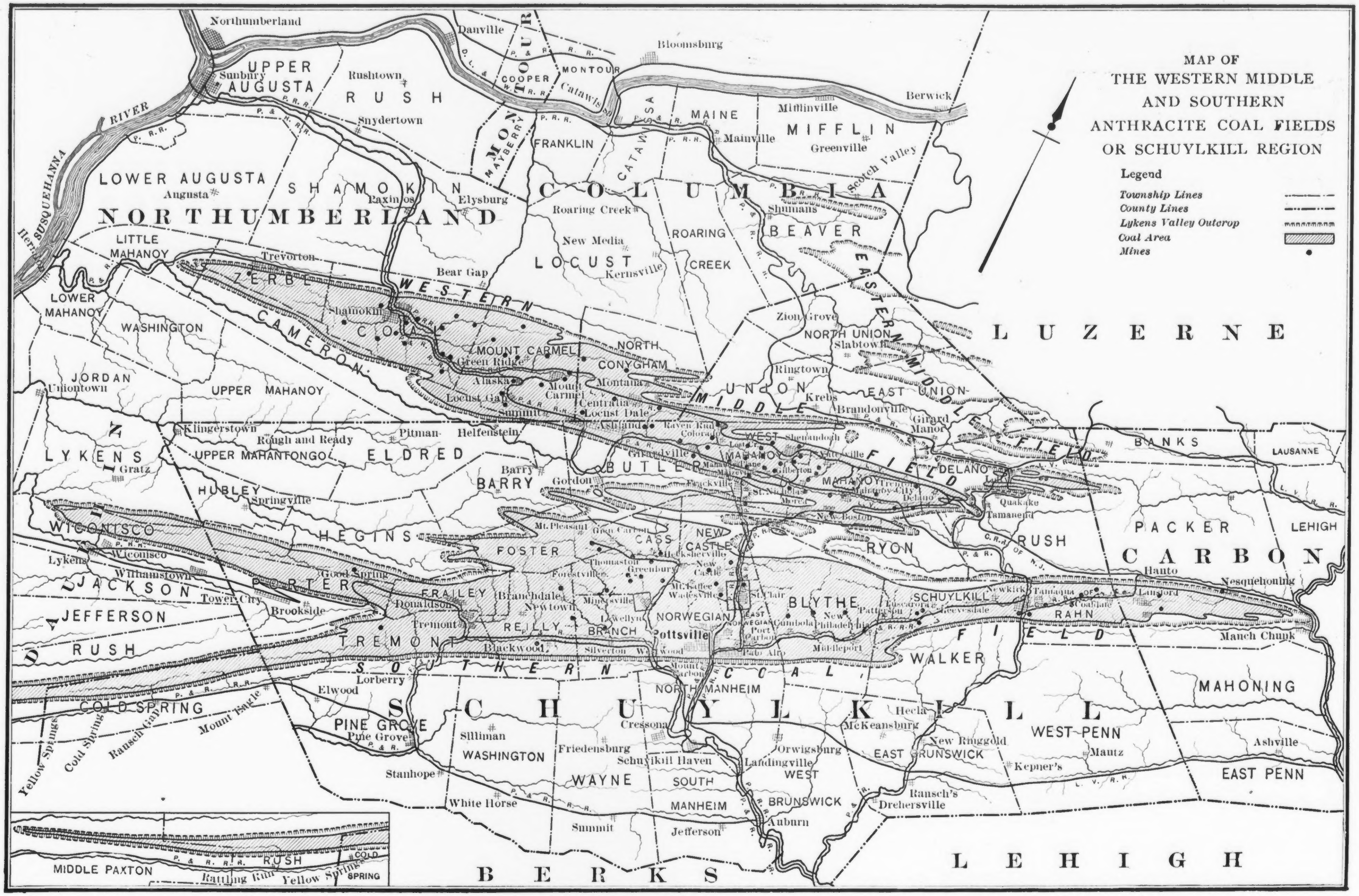
LUZERNE
MIFFLIN
NESCOPECK
BUTLER
FOSTER
SUGAR LOAF
BLACK CREEK
BEAVER
HAZLE
NORTH UNION
EAST UNION
SCHUYLKILL
KLEINE
CARBON
PACKER
BANKS
LAUSANNE
LEHIGH
Shickshinny
Glen Lyon
Alden
Wanamie
Warrior Run
Sugar Notch
Fairview
Penobscot
Glen Summit
Bear Creek
Rita
Dorrance
Wapwallopen
Berwick
Nescopeck
Summerville
Greenville
Scotch Valley
Black Creek
Seybertsville
Sugar Loaf
Mt. Conyngham
Rock Glen
Tomhicken
Penn Glen
Derringer
New London
Slabtown
Rington
Sheppton
Drums
Freeland
Upper Lehigh
Pond Creek
White Haven
Tannery
Sandy Run
Drifton
Drifton Junction
Jattinger
Hollywood
Milnesville
Harleigh
Ebervale
Eckley
Hazleton
Harwood
Humboldt
Stockton
Buck Mountain
Leslie's Run
Rockport
Weatherly
Jeanesville
Beaver Brook
Tresckow
Auchwick
Ben Meadow
Hudsondale
Black Creek Junction
Penn Haven Jc.
Pottsville Conglomerate
Penna. R. R.
Bloomsburg Div. Delaware Lackawanna
Western R. R. N.
Sunbury Div. Pennsylvania R. R.
L. V. R. R.
C. R. R. of N. J.
D. S. & S. R. R.
C. R. R. of N. Y.
Lehigh River
Lehigh River


MAP OF
THE WESTERN MIDDLE
AND SOUTHERN
ANTHRACITE COAL FIELDS
OR SCHUYLKILL REGION
Legend
Township Lines
County Lines
Lykens Valley Outcrop
Coal Area
Mines
NORTHUMBERLAND
COLUMBIA
LUZERNE
SCHUYLKILL
CARBON
LEHIGH
BERKS
DAUPHIN
MONTOUR
WESTERN
MIDDLE FIELD
EASTERN MIDDLE FIELD
SOUTHERN COAL FIELD
SUSQUEHANNA RIVER
Northumberland
Sunbury
UPPER AUGUSTA
LOWER AUGUSTA
Augusta
RUSH
Rushtown
Snydertown
SHAMOKIN
Paxinos
Elysburg
LITTLE MAHANOY
LOWER MAHANOY
WASHINGTON
JORDAN
Uniontown
UPPER MAHANOY
ZERBE
Trevorton
CAMERON
COAL
Shamokin
Bear Gap
MOUNT CARMEL
Green Ridge
Alaska
Mount Carmel
Locust Gap
Summit
Centralia
Locust Dale
Ashland
Montana
NORTH CONYGHAM
CONYGHAM
Danville
COOPER
MAYBERRY
FRANKLIN
Catawissa
CATAWISSA
Bloomsburg
MAINE
Mainville
MIFFLIN
Mifflinville
Greenville
Berwick
Scotch Valley
Roaring Creek
New Media
LOCUST
Kernsville
ROARING CREEK
BEAVER
Shumans
Zion Grove
NORTH UNION
Slabtown
UNION
Ringtown
Krebs
EAST UNION
Brandonville
Girard Manor
LYKENS
Gratz
Klingerstown
Rough and Ready
UPPER MAHANTONGO
Pitman
Helfenstein
ELDRED
Barry
BARRY
Gordon
BUTLER
Girardville
Raven Run
Colorado
WEST MAHANOY
Shenandoah
MAHANOY
Frackville
St. Nicholas
Mahanoy City
Delano
DELANO
New Boston
Quakake
Tamanend
BANKS
LAUSANNE
LEHIGH
PACKER
HUBLEY
Springville
HEGINS
WICONISCO
Wiconisco
Lykens
Williamstown
JACKSON
Tower City
PORTER
Brookside
Good Spring
JEFFERSON
RUSH
FOSTER
Mt. Pleasant
Glen Carbon
CASS
Thomaston
Forestville
Greenbury
NEW CASTLE
Heckscherville
New Castle
Mt. Laffee
Wadesville
FRAILEY
Donaldson
Tremont
TREMONT
Branchdale
Newtown
REILLY
Minersville
Llewellyn
BRANCH
Blackwood
Silverton
Westwood
NORWEGIAN
Pottsville
St. Clair
EAST NORWEGIAN
Port Carbon
Palo Alto
Mount Carbon
NORTH MANHEIM
BLYTHE
New Philadelphia
Cumbola
Middleport
Patterson
SCHUYLKILL
Tuscarora
Reevesdale
Newkirk
Tamaqua
Coaldale
Lansford
RYON
RUSH
Hauto
Nesquehoning
RAHN
Manch Chunk
WALKER
MAHONING
COLD SPRING
Mount Eagle
Rausch Gap
Cold Spring
Yellow Springs
Lorberry
Elwood
PINE GROVE
Pine Grove
Stanhope
Stillman
WASHINGTON
Friedensburg
WAYNE
White Horse
Summit
Cressona
Schuylkill Haven
SOUTH MANHEIM
Jefferson
Orwigsburg
Landingville
WEST BRUNSWICK
Auburn
Hecla
McKeansburg
EAST BRUNSWICK
New Ringgold
Rausch's
Drehersville
Kepner's
WEST PENN
Mantz
Ashville
EAST PENN
MIDDLE PAXTON
RUSH
Rattling Run
Yellow Springs
COLD SPRING

Hoisting Coal in Pennsylvania

Some of the Companies Are Returning to the Use of Wood for Head Frames in Preference to Steel

BY JOHN H. HAERTTER*

The subject of hoisting in the anthracite coalfields of Pennsylvania is so extensive, that I shall only attempt to investigate the question in a general way, confining myself for the most part to a brief description of the present methods, and illustrating what are considered some of the latest designs of hoisting apparatus.

When the mining of anthracite was first begun, the coal came from water-level drifts or tunnels, and hoisting appliances were both unknown and unnecessary. The exhaustion of the coal tributary to the tunnels and drifts was rapid, and further mining demanded a new kind of outlet. This was found in the shallow single-track slope, for which the hoisting apparatus consisted of the horse and gin. Time and the increasing demand for the fuel brought into use the double-tracked and deeper slopes and the geared hoisting engines. Next came the shallow shafts of small dimensions and improvements in hoisting-engine design, followed later by the deeper shafts of greater dimensions and remarkable improvements in the design and construction of the hoisting equipment needed to successfully operate such openings.

The Location of a Shaft

The size of a shaft having been determined, the next problem in order is the selection of a suitable location. This is of vital importance, and is decided only after a careful study of all the conditions, such as geological construction of the ground to be developed; the topography of the surface in the vicinity; the proximity of large streams and the consequent danger from floods; the location of the breaker and railroad tracks to transport the coal from the shaft to the tipple. Where conditions are favorable, the approved plan has been to locate the shaft centrally in the synclinal trough of the main basin of the territory to be worked. This permits of quickly reaching both sides of the basin, and where water-hoisting is done, all the water is collected at the lowest point and raised at once to the surface. Such a location is undesirable in the Wyoming field in the valley traversed by the Susquehanna river from Pittston to Nanticoke, where the material consists of clay, gravel and quicksand, the composition of the former river bed. This accounts for the present location of many of the shafts in this portion of the field, a more desirable location having been prevented for the reason stated.

*Engineer with Lehigh Valley Coal Company, Wilkes-Barre, Penn.

Briefly stated, the foundations for a pair of high-speed engines, such as are now used for shaft hoisting, are almost universally of concrete. This style of construction has rapidly replaced the brick and stone foundation, having been found to be more durable and slightly cheaper than stone. The modern hoisting engines being heavier in design, and more costly than formerly, and from the fact that their location, as well as the work they are designed to perform is to be permanent, the material and construction of the foundation upon which they work now receives more careful consideration than formerly. Modern practice even furnishes for an inside-slope engine a well constructed concrete bed.

FIG. 1. HOISTING PLANT AND CONVEYER LINE TO BREAKER AT TRUESDALE COLLIERY, NEAR NANTICOKE, PENN.

The Installation of a Hoisting Engine

Next in order is the installation of the hoisting engines and other hoisting apparatus. Most shafts are sunk with a sinking outfit, of which the sinking engines and temporary head frame are the most important parts. The engines are so located and housed that work on the permanent engines can be performed and completed while sinking operations are going on. At the same time, concrete piers or walls are erected and the permanent head frame is built, the parts being assembled for quick erection.

In a study of the methods of hoisting about an anthracite operation, the surface plant is, as we know, of first importance, and, therefore, more cautiously designed and constructed than formerly. To hoist the same tonnage from the deep pit, as was formerly hoisted from smaller shafts of less depth, first-motion engines of heavy design and of high rate speed have almost entirely replaced the second-motion geared engines, the latter, however, still being given preference where it is desirable to haul heavier trips at a slower speed; they still exist at tender shafts and on slopes for that reason.

Safety and Economy Assured By A Good Hoist

The hoisting engine or plant, more especially the heavy first-motion engine now used to hoist from a main shaft, is

in reality the mainstay of the modern anthracite operation. Upon its mechanical construction is dependent not only the safety of the men raised and lowered each day, but also the output of the colliery. It is therefore essential that all its mechanical parts be perfectly constructed in every detail. The failure or breakage of any part often results in a suspension of operations at the particular slope or shaft, and where such an opening is a main shaft upon which the breaker is entirely dependent for its supply, a serious delay is sure to occur.

The advancement and improvements which have taken place, and the principal factors to which they are directly due, are the increasing depth from which hoisting must now be done, and the necessity of maintaining the same output with the increased depth.

The improvements in design most deserving of notice and mention are the reversing gear and brake mechanically operated; the design of the valves with a view to the saving in the consumption of fuel; the conical type of drums which has advantages over the old wood-lagged straight drum; the attachment of the driving rods directly to the drum; the friction clutch which permits of rapid hoisting from several different levels; and devices for the prevention of overwinds.

Some of the recent installations of engines of latest design for high-speed hoisting from shafts are shown in the illustrations, among which special attention is called to Fig. 6, which shows a pair of 42x60-in. first motion engines designed and built by the Vulcan Iron Works, of Wilkes-Barre, Penn., for the Lehigh Coal and Navigation Company, to be used exclusively for hoisting water at the company's No. 9 water shaft near Lansford, Penn. The engines are link reversing with a wood-lagged drum of 12-ft. 8-in diameter and 14-ft. 6-in. face, and are equipped with steam reverse, steam brake, and tail crossheads. These engines are elaborately housed and are unusually attractive. At the time of this writing the engines are about ready to begin active service. The Philadelphia & Reading Coal and Iron Company, who build their own engines, have in service a few pairs of engines of greater dimensions (45x60 in.), than those just described.

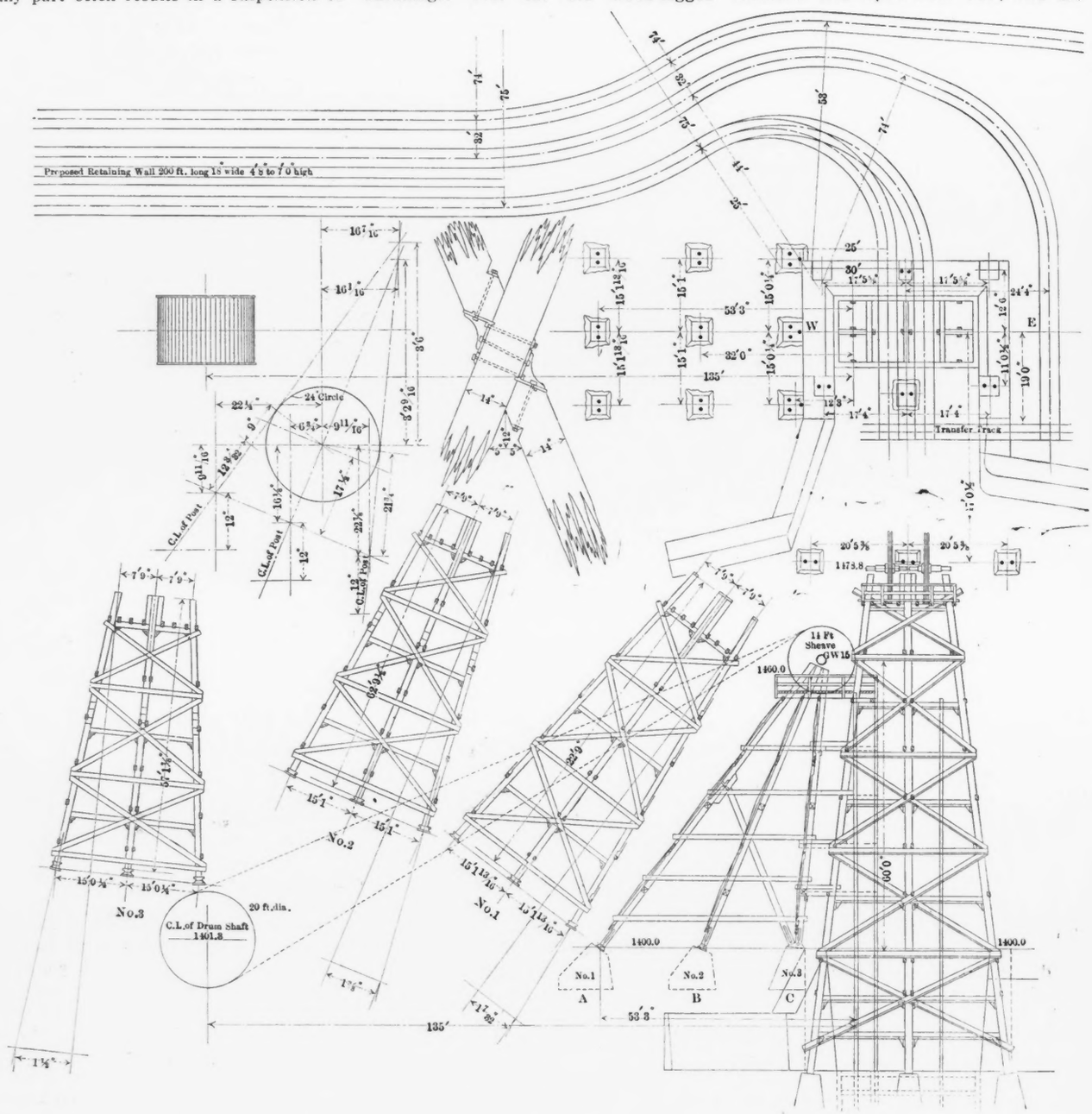


FIG. 2. EAST BROOKSIDE WATER SHAFT HEAD FRAME OF PHILADELPHIA & READING COAL AND IRON COMPANY

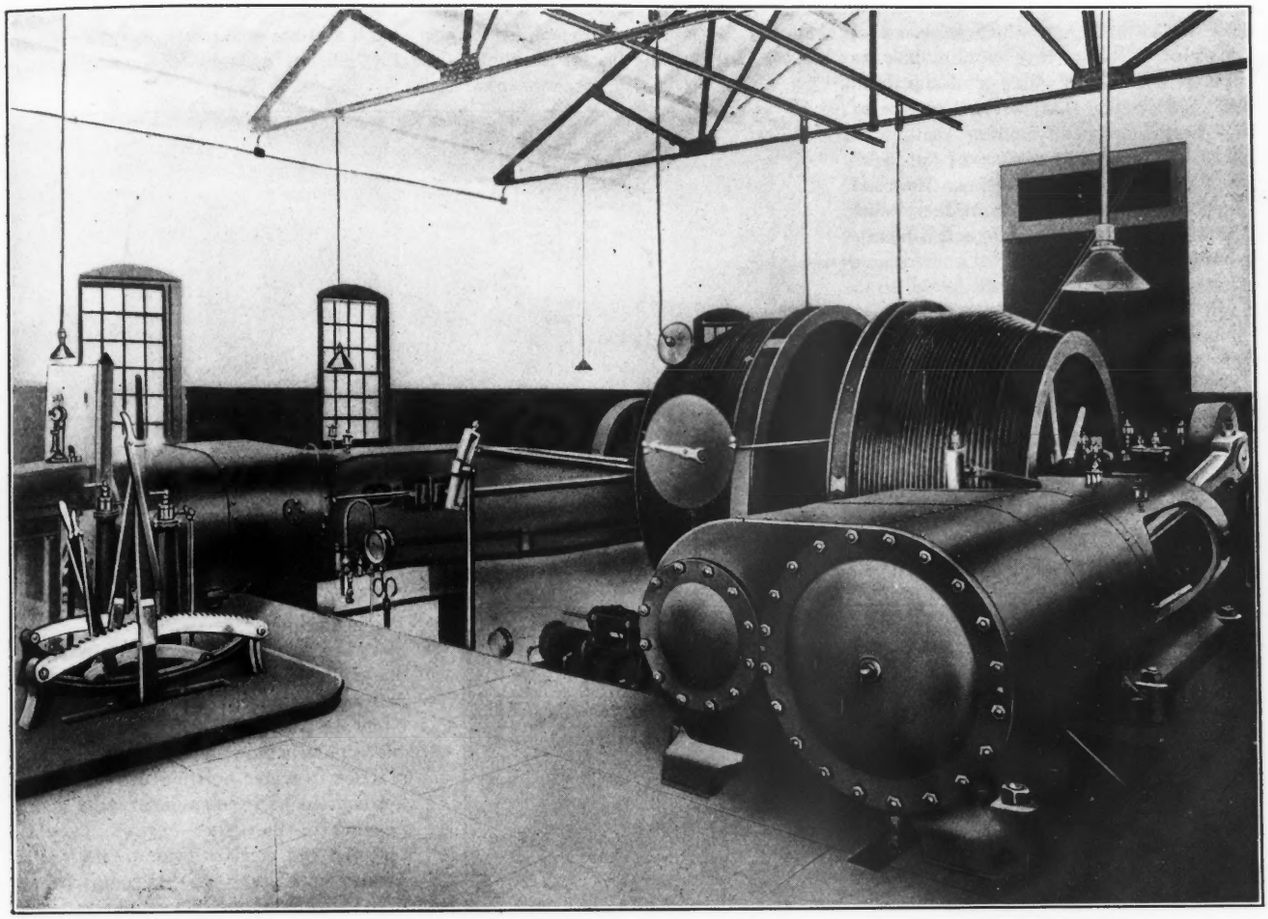


FIG. 3. FIRST MOTION VULCAN ENGINES AT TRUESDALE SHAFT, DELAWARE, LACKAWANNA & WESTERN COAL COMPANY

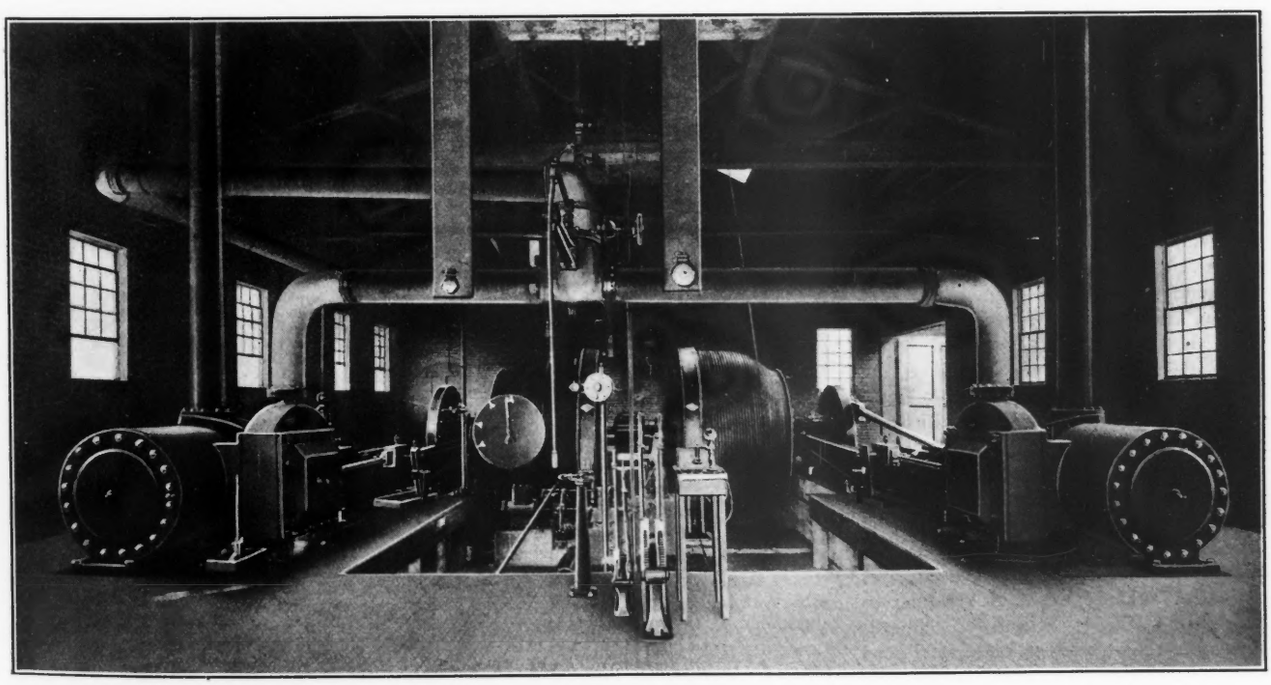


FIG. 4. FIRST MOTION ENGINES AT PINE RIDGE COLLIERY OF DELAWARE & HUDSON COMPANY AT PARSONS, PENN.

Next in point of order both as to date of installation and design of engines, are those shown in Fig. 3, which is a view of a pair of 30x48-in. first motion, link-reversing engines of Vulcan design and build, and doing shaft service at one of the best equipped modern anthracite plants, the Truesdale colliery of the Delaware, Lackawanna & Western Railroad Company, located near Nanticoke, Penn. The drums are of the semi-conical metal-grooved type, 9-ft. 10-in. to 11-ft. diameter, working tight and loose for hoisting from different levels. The engines are equipped with steam reverse, steam brake and steam-clutch shifter.

Fig. 4 shows a pair of 30x60-in. first motion engines, with semi-conical drums from 8- to 11-ft. diameter working tight and loose to facilitate hoisting from different levels. They have the same equipment as those in Fig. 2, and are earlier Vulcan design. These engines are in service at the Pine Ridge colliery shaft of the Delaware & Hudson Company, at Parsons, near Wilkes-Barre, Penn. Fig. 5 differs from Figs. 2 and 3, showing two cylindrical or straight metal-grooved drums, of 8-ft. diameter, and working tight and loose. The engines are first motion, 24x48 in., link reversing, have steam reverse, hand brakes, and hand-clutch shifter. They are located at the shaft of the Pennsylvania Coal Company's Barnum colliery, near Pittston, Pennsylvania.

In connection with the accompanying illustrations there are several things worthy of notice and mention. One is the marked difference in the construction of the engine houses over that of a few years ago, and the attractive appearance of the interior in general. Fig. 3, it will be noticed, shows the roof trusses to be of steel construction. Another apparent improvement is the absence of the flooring over the reverse and brake apparatus so that the same is at all times in full view of the engineer. Among other smaller things will be noticed the close proximity of telephones to the engineer's station, electric lights, etc.

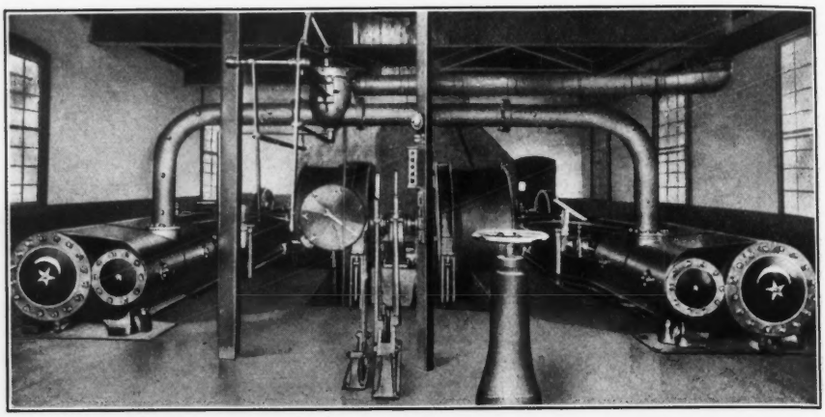


FIG. 5. FIRST MOTION ENGINES AT BARNUM COLLIERY, PENN. COAL COMPANY, PITTSTON, PENN.

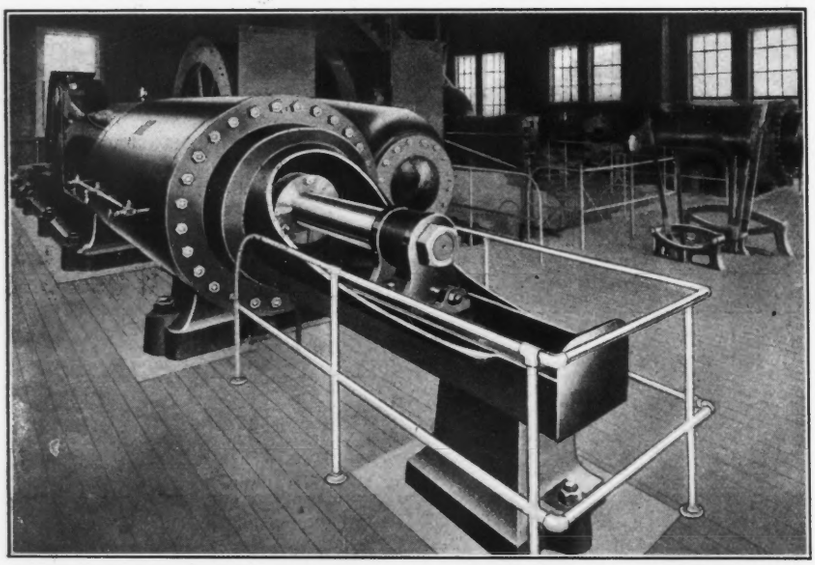


FIG. 6. FIRST MOTION ENGINES AT WATER SHAFT OF LEHIGH COAL AND NAVIGATION COMPANY AT LANSFORD, PENN.

Hoisting Water

Where a shaft is of several compartments, so that coal and water are hoisted, the methods of arranging the engines vary, and are adapted to suit the views of the officials of the different companies. We accordingly see two pairs of engines placed side by side in one building, at one colliery; at another plant we find one pair neatly housed in one building with a duplicate pair placed directly behind them and similarly housed. The most general practice in water hoisting has been to set the engines at right angles to the line of hoisting of the other engines, in which case the end compartment of the shaft is divided into two smaller compartments. The hoisting of water in tanks raised by high-speed engines has reached an advanced stage and few shafts are now put down without a compartment for this purpose. In fact there are now many shafts which have been sunk, and in use exclusively for hoisting water. That particular attention is paid to this branch of hoisting is evidenced by the first-class equipped plants throughout the field. Most of the water hoists in use are specified in Table I.

TABLE I. WATER HOISTS OPERATING IN THE ANTHRACITE REGION

Holding Company.	Operating Company.	Plant.	Size Engines.	Hoist, Feet.
Phila. and Reading Coal and Iron Co.	Phila. and Reading Coal and Iron Co.	Gilberton:		
		North Hoist	45" x 60"	1070
		South Hoist	45" x 60"	1070
		Maple Hill	45" x 60"	676
		Wadesville:		
		New Shaft	40" x 60"	740
		Old Shaft	32" x 72"	780
		Silver Creek	30" x 60"	904
		Lincoln (2 Pair)	45" x 60"	900 each
		East Brookside	45" x 60"	1800 approx.
Penna. R. R. Co.	Mineral R. R. & Mining Co.	Luke Fidler	32" x 48"	960
	Lytle Coal Co.	Lytle	36" x 60"	1500
	Susquehanna Coal Co.	Wm. Penn No. 2	32" x 48"	950
		Glen Lyon No. 6	30" x 72"	920
	Union Coal Co.	Hickory Ridge	*18" x 36"	600
		Scott No. 2	?	1000
	Summit Branch Mining Co.	Bear Valley No. 1	36" x 60"	1650
		Bear Valley No. 2	36" x 60"	1650
Lehigh Coal & Nav. Co.	Lehigh Coal & Nav. Co.	Colliery No. 9	42" x 60"	?

* Geared engines. All others first motion.

In addition to the above hoists, the Delaware, Lackawanna & Western Railroad Company put in operation in August, 1905, a water-hoisting plant electrically

equipped, consisting of an 800-h.p. electric hoist; buckets 6 ft. in diameter and 20 ft. in depth, of 4000 gal. capacity. The length of the hoist is 520 feet.

Safety Devices

While most of the fatalities resulting from accidents while hoisting men from a shaft or slope were due to the point the men have been dashed into the shaft below.

When high-speed first-motion engines were first used, many overwinds took place and wrought much destruction to shafts and head frames. The total destruction of the steel head frames at the Gilberton water-shaft, due to an overwind, occurred in 1902. An entangled

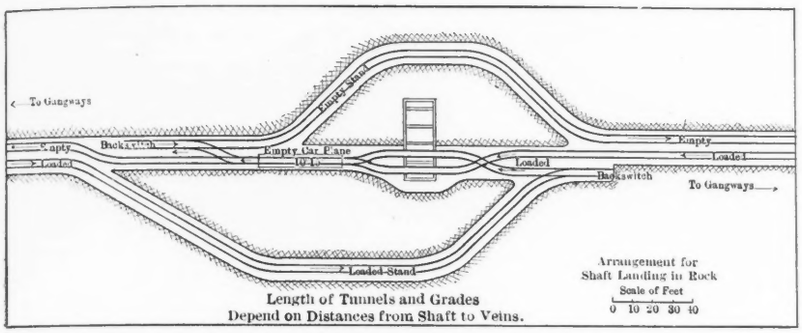


FIG. 7. IDEAL PLAN FOR HAULAGE SYSTEM AT FOOT OF SHAFT

breaking of hoisting apparatus, other than the engine or its parts; nevertheless, many lives have been lost through the failure of the mechanism of the engine to work properly; and the engineer, capable, but powerless to control it, has been compelled to witness the ascension of the cage with its load of human freight to the top of the head-frame, at which mass of bent and broken steel members alone remained. A railroad locomotive was hitched to it and pulled it apart and out of the way for erecting another.

Such accidents brought into use devices for preventing the liability of overwinding. These had the desired effect, and several makes are now in use. The engines at Lansford, shown in the illustration, are equipped with the Nicholson patent automatic engine stop. The engines have tight and loose drums for the purpose of hoisting from different levels, one drum being keyed to the engine shaft and the other loose, but held fast for winding by means of a toothed clutch which is operated by a steam-clutch shifter whose speed is controlled by an oil cataract. The automatic safety device is especially designed for hoisting from more than one level, inasmuch as it automatically adjusts itself for any number of levels, thus eliminating any chance of failure on the part of the engineer to make the proper adjustment for the desired level. In hoisting from different levels it is obvious that there are many more chances for overwinds than from a single lift, which is generally caused by the confusion of the many signals the engineer must obey. If for any reason the engineer mistakes the signal, this device will operate at the proper time, as

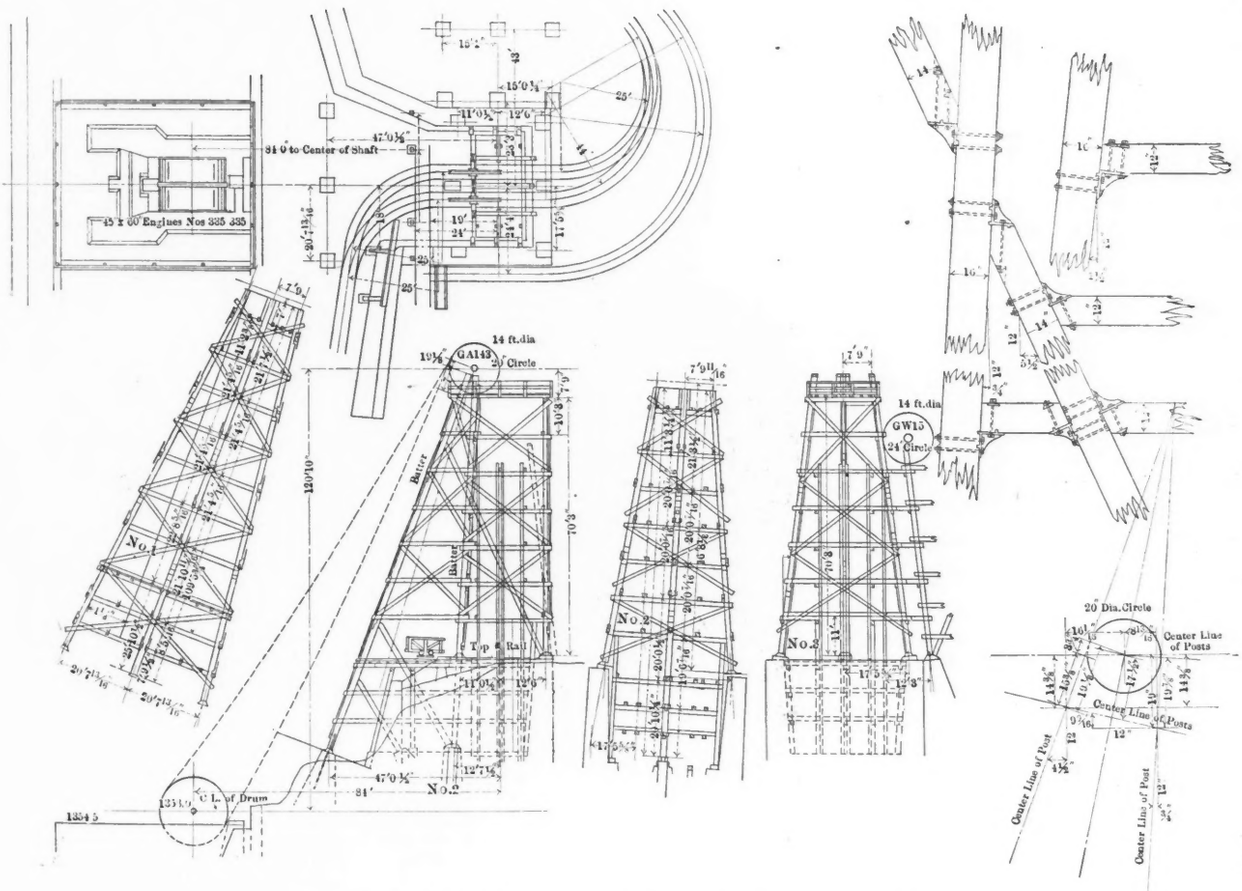


FIG. 8. EAST BROOKSIDE SHAFT HEAD FRAME, NEAR POTTSVILLE, PENN.

the automatic adjustment is made when the rope is changed for hoisting from the desired level. Most of the overwind devices heretofore built have been designed to prevent an overwind from a single lift. The one here referred to is also being used by the Delaware, Lackawanna & Western Railroad Company, and the Delaware & Hudson Company.

Designing Head Frames

Interesting in connection with modern surface hoisting plants are the newly designed head frames erected over the shaft for supporting larger sheave wheels than were formerly used. The selection of the material for a head frame still remains a matter of choice between steel or wood, and although steel for a time was almost exclusively used, some of the companies are returning to the wood construction, of improved design. The head frame of the new Sayre shaft of the Lehigh Valley Coal Company, at Mt. Carmel, is of steel. The two head frames at the East Brookside shaft of the Philadelphia & Reading Coal and Iron Company, in the Lykens district are of wood. One is erected over the water-hoist compartment and the other over the coal shaft. They are shown in the illustrations, and in detail in Figs. 2 and 8. They were framed and all parts marked at the company's East Mines lumber yard near Pottsville, from which place they were shipped to their location, all ready for erection. The great hight and length of the braces of the coal-shaft frame, as will be noticed, were due to the fact that they are located on the side of a steep hill, and because the engines, powerful 45x60-in. first-motion machines, were already in place, having hoisted from the slope near the shaft. It was necessary to get enough distance to permit the hoisting rope to fleet properly on the drum.

These head-frames were constructed of wood after much consideration as to what would be the best material, and it was even admitted by several structural companies that wood would be the best. The company in selecting wood for the material, was highly influenced by the destruction of its expensive steel head-frame at the Gilberton Water Shaft in 1902 when an overwind entirely demolished it. It was replaced at once by a wooden frame. Another overwind broke one of the 16x16-in. ties supporting the sheaves, but the head-frame withstood destruction.

The accident at Gilberton was followed closely by one at the Knickerbocker colliery of the same company and the destruction of the steel frame made room for another of wood. The design of the Brookside frames, as will be seen, is most substantial. They are independently erected, being only connected by a light tie piece, so that an accident will destroy only one and not both. These head frames have just been put into use.

Concentration of Hoisting

The methods of hoisting become broad when we consider a general application of them to the profitable transportation of the mined product. Associated with haulage, the two must be studied and operated one with the other, since the profitable preparation of one is dependent on the other; on the one hand our haulage capacity is diminished if the hoisting equipment is inadequate to relieve the haulage of its entire output; on the other hand, if the haulage methods are not capable or sufficient to supply to the hoisting equipment the work they were designed to perform, then there has been an unwarranted over-expenditure in the installation of the hoisting plant and machinery.

A combined study of these two allied subjects, hoisting and haulage, taking into consideration the conditions existing in each particular locality, has resulted throughout the field in "concentration," which is now the prevailing plan upon which the opening, development and operation of a modern anthracite colliery is profitably conducted.

Where several breakers are in operation, each one having its hoisting outlet, their abandonment is frequently warranted, when it becomes profitable to take the coal from the territory feeding them, by mechanical haulage underground to the foot of the main shaft of a concentrated plant, where the shaft and powerful hoisting engines are used solely for raising the combined output to the surface. The concentration plan is not entirely due to the part exhaustion of the coal in certain sections, but has resulted from a careful study of economy and general conditions, in connection with which hoisting is such an important factor.

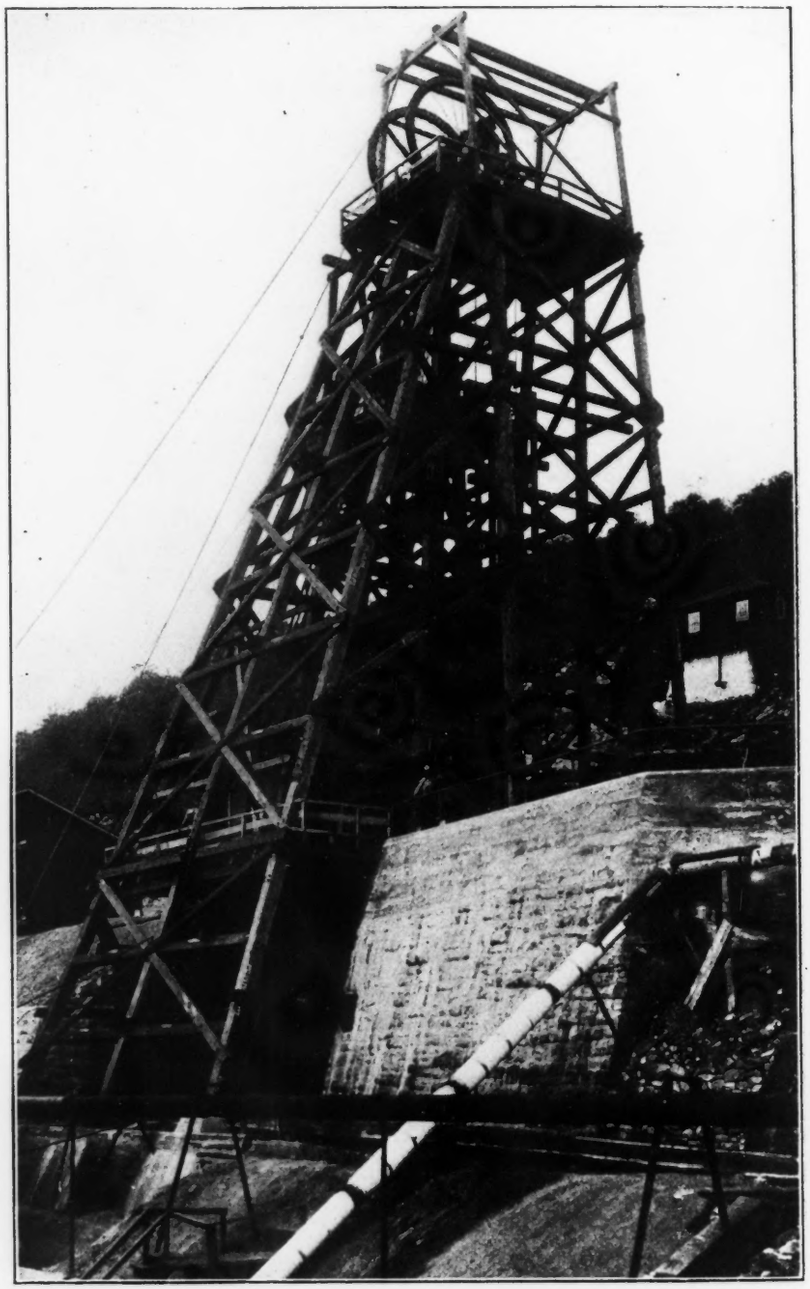


FIG. 9. EAST BROOKSIDE COAL SHAFT HEAD FRAME OF PHILADELPHIA & READING COAL AND IRON COMPANY

Examples of concentration worthy of mention are the Prospect plant of the Lehigh Valley Coal Company at Wilkes-Barre; the Packer and Sayre plants of the same company at Lost Creek and Mt. Carmel, respectively, and the Pine Knot colliery of the Philadelphia & Reading Coal and Iron Company in the Heeksherville valley, near Pottsville.

FIG. 10. BACK VIEW OF EAST BROOKSIDE COAL SHAFT HEAD FRAME

The idea of concentrating hoisting where it becomes advisable, brings into consideration various methods of getting the coal to the point of concentration. The time when only steam furnished the power and it was but necessary to decide the size of the engine to do the work, has passed.

Compressed air and electric hoists have come into extensive use. The first objections to the use of electrical equipment underground have been largely removed and electric hoists are now installed with little hesitation where conditions are known to allow it. Their use consists chiefly in hoisting the coal up underground slopes or rock planes which help to feed a main hoisting outlet, while in many places they are used on empty car planes to hoist the empty cars up the plane to a point sufficient in hight to give the cars momentum enough to run by gravity to the point of distribution. The current to the electric hoists underground is carried through the wire over the surface and thence down a bore hole near the power plant on the surface and along the roadways underground to the hoist. The same general remarks apply to the use of compressed-air hoists.

Steam Used Less Underground

The number of steam engines underground has decreased in recent years mainly because of the loss of pressure where the steam must be carried any great distance, and on account of the weakening of the roof and the rotting of the timber by the heat radiating from steam lines. Steam engines for furnishing power underground are now generally situated on the surface, and in close proximity to the boiler house; the rope is carried over a sheave wheel and thence down a bore hole and conducted over a series of pulleys to the landing of an inside slope or rock plane. Such slopes or planes are most frequently located near the main hoisting shaft, and the cars hoisted up the pitch, are dropped back over a switch to a turnout feeding the shaft. In mining the slightly inclined seams in the Wyoming region, the necessity of operating several inside slopes or planes is obvious, and the best methods for equipping them are invariably regulated by conditions.

Methods for Handling an Output

The rapidity with which the output of a shaft can be handled and the desired capacity necessarily maintained, in addition to the hoisting and haulage methods, is also dependent to a large degree on the arrangement of the foot and surface landings, where the handling of cars can be accomplished with ease and the least possible delay, and at the same time economically. Such arrangements vary widely throughout the field and a description of them would require much space. From their alliance with hoisting, however, they may be mentioned briefly. There are still a number of collieries where the mine car is hoisted directly from the mine up an incline connecting the slope and breaker and the coal dumped directly into the breaker. At other plants the coal is dumped inside the mine into gunboats, each holding generally the contents of two mine cars. There are now few cases where the coal is hoisted up a shaft directly into the breaker, although such arrangements were in existence before the mine laws prohibited the erection of the breaker over the shaft.

At some shafts the coal is hoisted on self-dumping cages, the car tilting and discharging its contents into a big conveyer line leading from the shaft to the breaker. This latter method is becoming extensively used. At many places the car is hoisted to a landing at the surface where it runs by gravity to the breaker and is again hoisted to the top of the breaker either up an incline or a vertical shaft, the empty cars being returned by

means of the empty car plane mentioned above.

One of the most satisfactory arrangements at shaft landings inside for facilitating the hoisting of a large output is shown in Fig. 7. Such arrangement requires little attendance and still less mechanical power to adequately supply a large shaft and high-speed hoisting machinery without loss of time. There are a number of other methods in successful use, but that shown in Fig. 7, used extensively by the Lehigh Valley Coal Company, both inside the mines and on the surface, has proved satisfactory, and is installed at nearly all new shaft operations. The grades and lengths are, of course, dependent on locality as to the distance between seams.

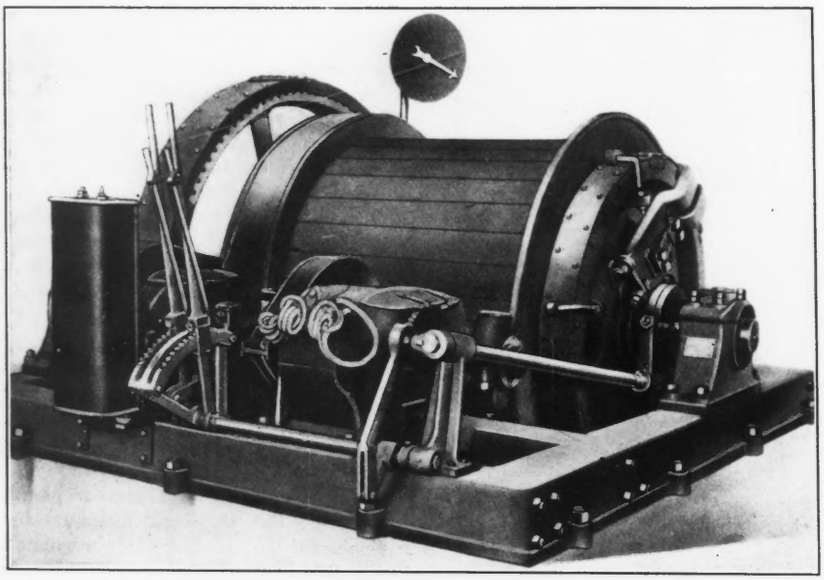


FIG. 11. ELECTRIC HOIST USED BY SUSQUEHANNA COAL COMPANY AT THEIR GLEN LYON COLLIERY

Powder Required Per Ton of Coal

In mining anthracite coal, black powder is generally used, but the quantity varies in the different seams; the thinner the bed, the more powder required per ton of output. In the early seventies in the Upper Lehigh field, as much as 100 tons of coal were mined per keg of powder, or ¼ lb. of powder per ton of coal. This was in the Mammoth seam, 60 ft. thick; in thinner, 5- to 7-ft. beds, in Lackawanna county, one keg of powder produced on an average, 30 tons of coal in 1896. Recent tests show that in mining a thin seam, 3 to 4 ft. thick, only 16 to 25 tons are produced per keg of powder.

Boiler efficiency is increased by the use of apparatus which records percentage of carbon dioxide in escaping flue gas. The draft can then be properly regulated.

Handling Water in Deep Workings

The size of a boiler plant, power house, and the capacity of the pumps installed in anthracite collieries depends generally on the depth of the workings. The mines in the southern anthracite field use from 8 to 12 per cent. of their coal output for making steam, as most of the mines at the present time hoist about 2½ tons of rock and pump from 10 to 15 tons of water against a head of 1400 to 1500 ft. per ton of coal produced. At some of the collieries in the Schuylkill field, pumps have been abandoned in deep shafts and large water tanks installed. It has been claimed that the cost of hoisting water in this manner is only one-third the cost of pumping the same flow. At one plant, a pair of powerful engines are used to raise two tanks, each with a capacity of 2000 to 2500 gal., from a depth of from 1350 to 1600 ft. in 1 min.; the tanks are filled automatically and when they reach the surface are discharged into chutes to convey the water away from the shaft.

Rope Haulage

The superior flexibility of a rope-haulage system is generally conceded, and renders it adaptable to the varying conditions under which coal is brought to the foot of a shaft. In most every mine, there is a slope or plane or both. The installation of such a system requires a comparatively small outlay, and its cost of maintenance is small compared with that of other systems. The tail-rope system requires less trackage and fewer cars for a given output than most other schemes of haulage. This method is easily controlled and is especially adapted to undulating roads.

The chief materials required for an installation of this kind, are a double-drum engine; wire ropes, the total length of which should be three times the length of the haulways; good single track, rollers and sheaves, and terminal arrangements. The engine should be located near the foot of the shaft. The usual speed at which a system of this kind is run is from 750 to 1050 ft. per min. on a straight road; but it is reduced to ½ to ⅓ of the normal speed when the trip is passing around curves.

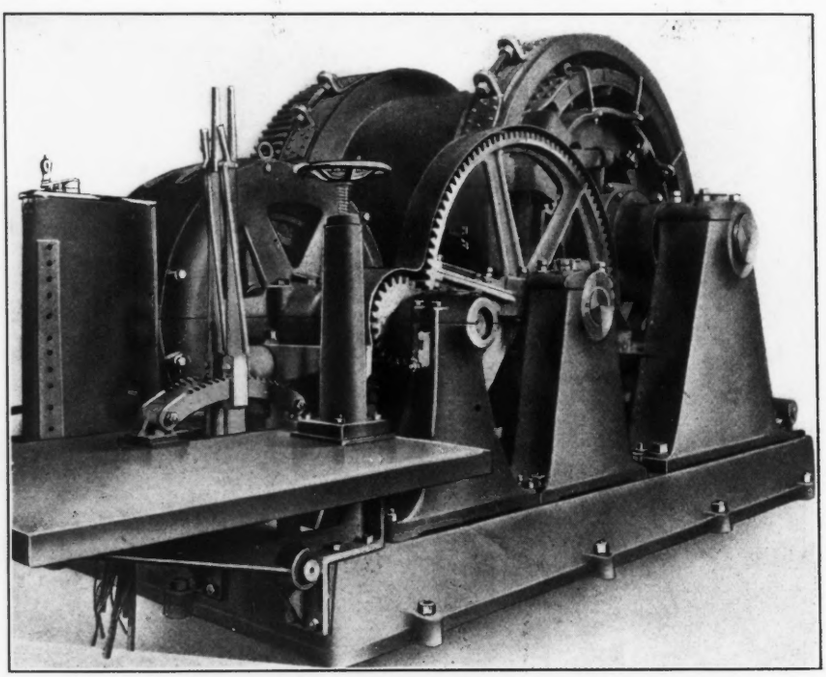


FIG. 12. STANDARD ELECTRIC HOIST IN USE AT AUCHINCLOSS AND BLISS COLLIERIES OF DELAWARE, LACKAWANNA & WESTERN COAL COMPANY

Electricity in Anthracite Mining

The Use of Electric Power for Operating Breaker Machinery, Water Hoists, Ventilating Fans and Mine Pumps Is Successful

BY H. M. WARREN*

Electricity was first used for electric power in connection with anthracite mining, in Pennsylvania, about twenty years ago, when an electric locomotive was installed. Since that time the introduction of electrically operated machinery has been carried on; but by far the greatest amount of apparatus which has been installed up to date, has been put in, in the last six years.

The original installations usually consisted of either a belt-driven or direct-connected generating set of from 100 to 150 kw. capacity, the power being used for operating electric locomotives, and in some instances, for driving pumps and hoists. As the advantages of this apparatus were appreciated, more units were installed, and usually the size of the unit was increased, so that in recent years, a common unit has been a 300-kw. set. When these units supplied only a few pieces of apparatus, the resulting load on the station was extremely variable, so that in such cases it did not pay to use anything other than the simple engine; this gave a low first cost of installation.

In later installations, more apparatus was installed and the loads became steadier, so that an increase in steam economy was considered. To accomplish this result, tandem or cross-compound engines were used. Very few engines have been operated condensing, however, owing to either the lack of water for condensing purposes, or its bad quality, which latter is due to the fact that the water is pumped out of the mines.

A High-tension Alternating-current Power Plant

The increased requirements for electric power, however, have been such, that in certain instances, it was finally decided to install a high-tension alternating-current power plant, distributing its power through sub-stations in the various collieries. One such installation is using steam-operated turbines, where the only water available for condensing purposes is that which is pumped from the workings. This station has been in use for five years, and the condensing operation has been satisfactory. It is of course not feasible to use surface condensing under these conditions, and barometric condensers must be used, on account of the acid condition of the condensing water.

*Chief electrical engineer, Delaware, Lackawanna and Western Railroad Company, Scranton, Penn.

A Central Power Plant

The Hampton central power plant of the Lackawanna company was built in 1903. The installation included three 500-kw. turbines. At the time this station was installed, it was thought it would meet the requirements for sometime to come. The increase was so great, however, that two additional units of the same size were afterward installed, and at the present time a 2000-kw. unit is being put in place, so that instead of the original capacity of 1500 kw. in 1903, the load has increased so that the requirements now call for a total of 4500-kw. capacity. The operation of this plant with its sub-stations, has been economical and extremely satisfactory. The sub-stations at the various mines require but little attention, and have given practically no trouble.

The electric locomotives installed in the anthracite mines up to 1902, were used solely for the purpose of hauling coal on the main gangways. It was apparent, however, that if a locomotive could be designed to handle the cars in the chambers, a greatly increased saving in haulage would result.

Gathering Locomotives

In June, 1902, the first electric locomotive, equipped with reels, so that the motor could be run into the rooms without the use of trolley wires in the chambers, was installed at the Cayuga Colliery, of the Lackawanna Company. At the present time, hundreds of this type of locomotive are in use, and to meet special requirements, locomotives have been built and equipped with a small hoist used for pulling cars up extremely steep chambers.

Electric locomotives of various weights and with differing motor equipments have been tried; from actual experience, however, it has been found that a 10-ton locomotive equipped with two 50-h.p. motors and a 6-ton locomotive equipped with two 25-h.p. motors, are best adapted to meet the requirements. With a heavier locomotive, and no increase in the horse-power of the motor, trouble will probably be experienced with the electrical equipment; it is therefore best to have the motor equipment large enough to handle any load the locomotive may be capable of hauling.

Electric Pumps

The first electrically operated pumps to be installed were of the duplex double-acting type. A pump of this kind has been in operation at the Lackawanna company's Bellevue colliery since 1896, and is still in service. On account of the uneven discharge of water from this type of pump, it was afterward considered best to use triplex pumps, and many of this kind have been installed. Perhaps one of the largest machines of this type is a double-acting triplex pump, handling 800 gal. per min., against a head of 800 ft. at the Avondale colliery of the Lackawanna Company. This pump is driven by two 25-h.p. motors, and has been in operation since 1901. The only trouble experienced with this machine is that which occurs to any pump handling bad mine water, that is, the action of the acid on the valves and water chambers. The operation of all the electrical pumps first installed was so satisfactory, that larger pumping equipments, electrically operated, were given consideration, and as a result, an electrically operated water hoist, designed to handle 42,000 gal. of water per min. against a 485 ft. lift, was installed, and has been in use a little over 2 years.

About this time high-efficiency centrifugal pumps were given consideration. These pumps for mine service are usually made entirely of acid-resisting bronze. In order to minimize the wear of the propeller to a reasonable amount, it does not seem advisable to have any single-stage work under a higher lift than 100 ft. Where it is necessary to pump water to a higher elevation, the number of stages should be increased.

Centrifugal Pumps

After pumps of this type were proved satisfactory, a 6-stage 14-in. bronze centrifugal pump, driven by a 900-h.p. induction motor, capable of handling 5000 gal. per min. against a 485 ft. head, was installed by the Lackawanna company. This pump has been in service about 14 months, and has given practically no trouble.

Certain mine-ventilating fans are driven by electrical motors, but there are not many such equipments, these being used only in cases where it is not absolutely necessary that the fan be in operation continually. A few breakers have been equipped with electrically operated machinery, and such installations have proved satisfactory. Motors are also being used to drive conveyer lines carrying the culm from banks to washeries.

Advantages of Electricity

In a general way, the increase of electrically operated apparatus was slow at

first, and limited principally to mine hauling, but as the advantages and convenience of this form of power were appreciated, its use was greatly increased, until now electricity is used in practically all branches of mining; one beneficial result of this condition is the elimination of steam and the consequent heat from the mines. The increased output of coal which can be handled, over a given track, and the reduced haulage costs with electricity, is also most important.

Wherever an electric motor can be used, and thereby eliminate a long steam line, a saving in the operating cost should result. This applies particularly to steam-driven apparatus, which is only used a few hours out of the 24; the steam line losses under these conditions are a much larger factor than they would be where the steam-driven unit is operated continuously, as in the case of a fan.

The use of motor drives in breakers eliminates many countershafts, belts and journals, and the consequent fire hazard. The breaker is also more accessible, and the motors are capable of handling momentarily heavy overloads.

When anthracite mining was in its early stages, the simplest kind of devices were used for ventilation. In the Lehigh region, where mines were comparatively deep, ventilation was effected by natural agencies. In the Wyoming valley in the sixties and early part of the seventies, steam jets were commonly used and in some mines, a furnace fire at the foot of the up-cast was employed.

Anthracite Mine Inspection

By L. M. Evans*

About the time of the passage of the act of June 8, 1901, the anthracite miners were of the opinion that the office of mine inspector as far as real mine inspection was concerned, had become a "dead letter." This is no reflection on former inspectors, for the reason that a proper performance of their duties was a physical impossibility. Their districts were too large; in fact about all of their available time was consumed in traveling, and in the investigation of mine accidents. Some of the districts covered a distance of 25 miles, with an average of 59 mines to the district, employing 4000 miners. The mine representatives realizing the dangers from this condition of affairs, decided to frame a bill providing for more frequent mine inspection; this proposed measure was taken to Harrisburg, with the result that a new law was soon enacted making many material changes in the office.

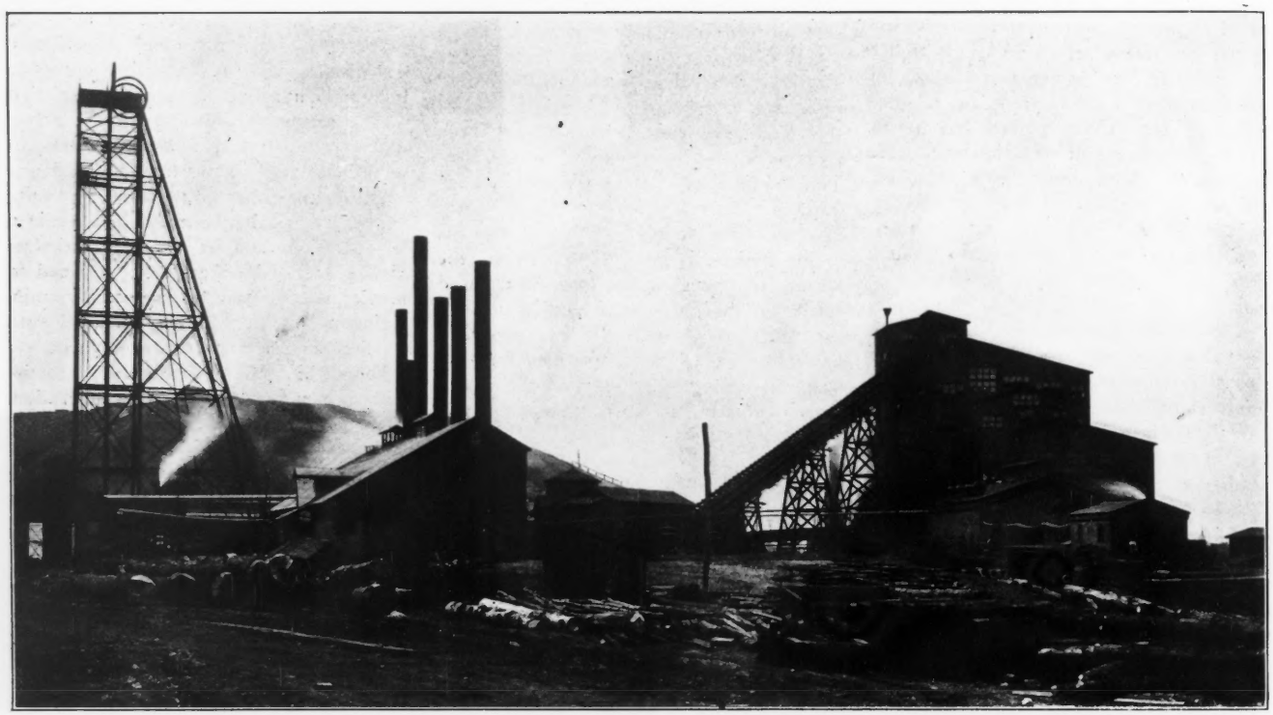
The new law divides the region into 20 districts instead of 8, and requires that the inspectors be elected by the people instead of being appointed by the Governor; it is also required that the face of every working place be inspected once in three months, instead of specifying that such places should be inspected as often as the inspectors' duties will permit. All the mine laws state in a general way just what shall constitute a satisfactory mine inspection. They may vary to suit local conditions, but they will have for their object the safety and health of the workmen, besides the protection and preservation of property.

Importance of Mine Inspection

Aside from the investigation of all accidents and the preparation of the information which constitutes an official report of the mining industry, thorough mine inspection is of material benefit to employer and employee; that some of the larger coal operators have long since recognized this fact is attested by their having employed qualified persons to act as company mine inspectors. A close study of the mine laws will show that their essential features are decidedly in favor of the industry from a practical standpoint.

Mine Inspection

In a condensed form, the anthracite mine law with regards to mine inspection is as follows: The inspector shall inspect all workings in his district once in every three months or oftener if necessary; he shall see that every necessary precaution is taken to insure the safety and health of the workmen at all times, whether provided for in the act or not; the inspector shall also visit the face of every working place and see that it is thoroughly ventilated. A record of the material circumstances of the visit is to be kept and his daily proceedings are to be sent to the chief of the department of mines in what is called a narrative report. In addition to this the inspector is required to prepare



PINE RIDGE BREAKER AT MINERS-MILL, PENN.

*Mine inspector, second anthracite district, Scranton, Penn.

a colliery report which is posted at the mine entrance, showing the number of each breast or entry inspected, and stating the condition of each working place by the words "good," "fair," or "bad."

After deciding which mine is to be visited, the inspector usually sends a telephone message on short notice to the company official in charge, stating that he is coming to visit the mines, and requesting that the company official meet him. The mine foreman is not informed of the visit until the inspector arrives at the mine.

The miners take exception to having the foreman present with the inspector, giving as their reason that the workmen are loath to report any complaint to the inspector under the fear of future unfair treatment from the foreman. They are not justified in this exception, for the reason that the foreman could advance the argument along the same line, that is, the miner should not be present while the inspector and foreman are inspecting his place. This is, of course, unreasonable. It is not necessary to point out any violations to a competent inspector, and if it is, the sooner he is replaced by someone more competent, the better it is for all concerned.

Points to be Observed

It would be impossible to give within this space all the details that are likely to occur while making an inspection of a mine, and for this reason only the important features will be mentioned.

Mine inspections are made in the morning for the reason that the miners and foremen spend this time in the face of the workings. Upon entering the mine, the inspector makes an examination of the map or print of the workings, noting in his book any features requiring attention; in fact he makes a survey of the physical features of the mine, and the thickness and nature of cover overlying any seam. His investigation of the map also shows all places that are approaching penned-up water or gas; the plan of ventilation and location of overcasts; the connections of the first and second openings, and the traveling ways throughout the mines; he has by this time an outline of the mines in his mind, and from this information he takes his bearings and decides which section of the mine he will inspect.

His first examination includes the ventilating apparatus and the hoisting appliances; it is observed whether these are daily examined and a record of the same kept for inspection. The surface inspection also includes all automatic devices to prevent cars from falling into the shaft and the investigation of gates, check signals, etc. It is also necessary to observe the arrangement and construction of the buildings with the view of preventing fires. Having completed these duties on the surface, the inspector descends the shaft or slope as the case may be. Any experienced person can determine the condition of the shaft by riding on the cage, but since daily examinations of the shaft are made, it is not necessary that the inspector make a second examination which of necessity must be made at night, or when the colliery is idle.

Arriving in the mine, he visits the fireboss station and examines reports of daily examinations, visits the medical room and makes an examination as to whether it is supplied with stretchers, splints, woolen and rubber blankets, oils for burns, bandages, and in fact everything that may enter into the complete equipment of an emergency hospital. In examining the stables, it is noted whether or not they are provided with a separate split of air. If the breaker is built over the shaft, inquiry is made as to what standing orders are in force, in case a fire should occur in the breaker. Having attended to these matters, the inspector proceeds on into the mines, paying close attention to the condition of roads with respect to width, roof, drainage, head blocks, or switches, safety holes at the foot of planes, or anything that may appear as being a source of possible danger.

Investigating the Workings

Entering that section of the mines where the chambers are to be inspected, the most important question is the condition of ventilation and roof; notice is taken of the quantity of air circulating on both the intake and return, and tests are made to determine whether it is charged or not. Arriving at the face of the gangway the quantity of air is again noted to determine whether there is considerable leakage, and what causes it.

When inspecting a chamber it is necessary to observe the condition and location of all crosscuts, and the nature of the roof. At the face of the mine, the pulse of the colliery, it is easy to determine whether there is a proper distribution of air in the working faces; should the place be smoky from lack of ventilation, which may include lack of doors, open crosscuts, doors standing open, small crosscuts, and many other factors which are likely to contribute to the lack of ventilation, careful note is made.

The question of ventilation being dismissed, attention is directed to the condition of the chamber with regard to safety; the fixed standard of perfection which exists in the inspector's mind, and which has been realized after considerable experience, is used as a standard for comparison. It may be that the props are too far or too close to the road, or that the road is too far from the face; it also frequently happens that too much coal is kept down, thus causing the miner to neglect his roof until the loose coal is loaded; this is one of the most prolific causes of accidents by falls of roof. Neglect of headblocks, and the proper securing of cars is another common offense. After visiting the chambers the inspection is continued up the manway, and through the second opening to the surface. If the inspection has brought forth any matters of great importance, a letter is addressed to the foreman calling his notice to the particular matter requiring attention and asking for a reply stating when the matter will be attended to.

The inspector's duties do not end with the mine examination, but include the investigation of accidents; the annual examination of candidates for certificates as mine foremen, and the preparation of annual reports of tonnage, accidents, etc. Considerable correspondence must be attended to, and the inspector cannot forget the fact that he is to take an examination every three years, and himself run a county campaign for a district office, with good chances of being defeated for being too officious.

Flushing Old Workings

The refuse, such as slate and bone, resulting from the preparation of anthracite coal, is now utilized in flushing the old workings for the future recovery of the pillars. The material is usually conveyed by a chute to a Williams crusher, running from 800 to 1200 r.p.m. and being driven by a 50- or 60-h.p. engine.' When an electric drive is used, it should be of the street-car-motor type to get good results. The crusher can handle about 60 tons of the material per hour, but much depends on the hardness of the rock. If the refuse contains hard rock, a jaw crusher gives better results than the Williams crusher. The amount of water required for flushing depends upon local conditions. Ordinarily 400 to 500 gal. of water per ton of material treated, are used. The installation of such a plant costs from $2000 to $3000.

A Unique Hospital Car

A novelty in the way of a hospital car is in use by the Lehigh Valley Coal Company. It was constructed at the suggestion and under the direction of one of the mine inspectors. The truck is made in the ordinary way, and the framework is supplied with springs upon which is constructed a platform. On the platform rest two upholstered cots, provided with upholstered side and center boards, and four seats for the attendants. The car is supplied with clean woolen and rubber blankets, a heater and an emergency case, containing all necessary equipment. The car is kept in a dry place at convenient points, and in case of accident, is rushed to the chamber or place where the mishap has occurred. The car can be used to advantage in small seams where men cannot stand erect to carry a stretcher.

Installation and Use of Turbine Pumps

Two Simple Methods Are Suggested for Calculating the Quantity of Water Discharged without the Use of Bulky Apparatus

BY M. S. HACHITA*

A turbine pump, electrically driven, with many points of interest by reason of its novelty as well as its practical utility, has been installed at the Maltby Colliery, Forty Fort, Penn. This type of pump is remarkable for its simplicity of action and entire freedom from intricate parts. It is heavily constructed of such materials as will withstand the wear of gritty water, and every part of the machine, such as the shell, impellers, guide vans, shaft and bearings are designed for high speed.

The machine is built in compact form, and is accessible at all points. All of the working parts are made so simple as to secure the greatest amount of freedom from wear and tear. The pump was installed in May, 1906, and is located along the tail-rope haulage road about 5000 ft. south of the main shaft. The installation consists of a 150-h.p. direct-current motor, No. 13L, type s, shunt wound, 500 volts, 1200 r.p.m., 245 amperes, manufactured by the Westinghouse company, and one 6-in. 4-stage turbine pump, manufactured by the Jeanesville Iron Works Company, Hazleton, Penn.

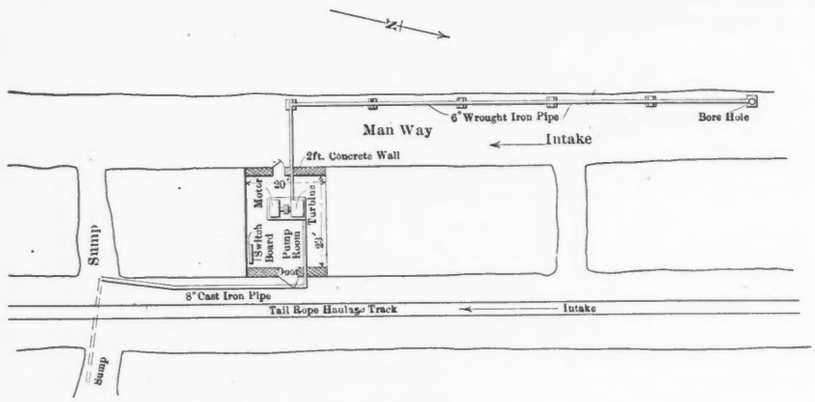


FIG. 1. PLAN SHOWING GENERAL ARRANGEMENT OF PUMP ROOM

General Dimensions

The pump room is located in the cross-cut between the rope haulage and the traveling way. The inside dimensions of the room are 23x20 ft. and the average hight is about 10 ft. The roof is of good sandstone formation and props are not needed. Concrete walls, 2 ft. thick, are built on both sides of the room with a 5½-ft. door on the side of the haulage road and a 3-ft. door on the other side. The dimensions of the foundation for the pump and motor are 9 ft. 10¼ in. by 5 ft. 5½ in. on top. It is made of concrete of the common proportion, 1:2:5, and is a few inches above the floor level. The bottom is also laid with concrete. The principal dimensions of the foundation and side and end elevations and the general arrangement of the pump and motor are shown in Fig. 2. Fig. 1 shows the general arrangement of the pump room and pipe connections.

The sump is located about 30 ft. south of the pump room and is 25 ft. deep. The suction pipe is 8-in. cast iron; a foot valve and a strainer are provided. The maximum lift in the suction is about 22 ft., but under normal conditions this lift is in the neighborhood of 12 ft. The delivery pipe is 6-in. wrought iron and is 167 ft. long from the pump to the foot of the bore hole. A 6-in. gate valve is located in the delivery pipe about 2 ft. from the pump. This valve is closed when the pump is stopped.

The delivery pipe is laid on bents 2x 2 ft., and 3 ft. high along the rib in the traveling way. These bents are spaced 25 ft. centers and are on the same level from the pump to the foot of the bore hole. The discharge pipe is connected to a cast-iron pipe of the same dimensions at the foot of the bore hole. It is provided with a 2½-in. primer supplied with a valve, and rests vertically on bents as shown in Fig. 3.

Between this cast-iron pipe and the roof, and held tightly against the roof, a bronze pipe, two feet in length is used. The bore hole is 12 in. in diameter, 364 ft. deep, and is lined with an 8-in. wrought-iron pipe, which is cemented in the hole so that when the pipe is worn out the hole will still have a lining of solid cement; the upper end of the lining is 3 ft. above the natural surface of the ground. A wooden trough is built around the dis-

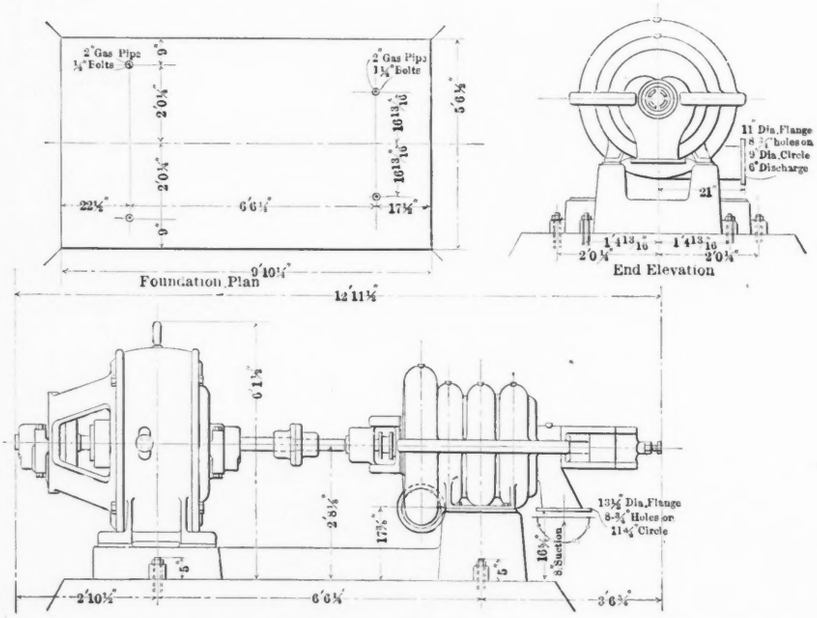


FIG. 2. FOUNDATION PLAN FOR FOUR-STAGE TURBINE PUMP AT LEHIGH VALLEY COAL COMPANY'S MALTBY COLLIERY

*Engineering department, Lehigh Valley Coal Company, Wilkes-Barre, Penn.

charge end to collect the water which is conveyed through a 10-in. pipe, laid under the road, to the creek.

The pump is designed to handle 800 gal. of water at 800 r.p.m. Since it runs 24 hours per day, the daily output is 1,152,000 gal, against a 374-ft. head or 430,848,000 ft.-gal. per day. The following is an approximate cost of the pumping plant installation; labor, $1381; materials $8635, making a total expenditure of $10,016.

Flushing Operations

The turbine pump handles all the water produced from the flushing operations in the upper lifts. The distance between the sump and the flushing district is about 2000 ft. The area being filled is sufficient-

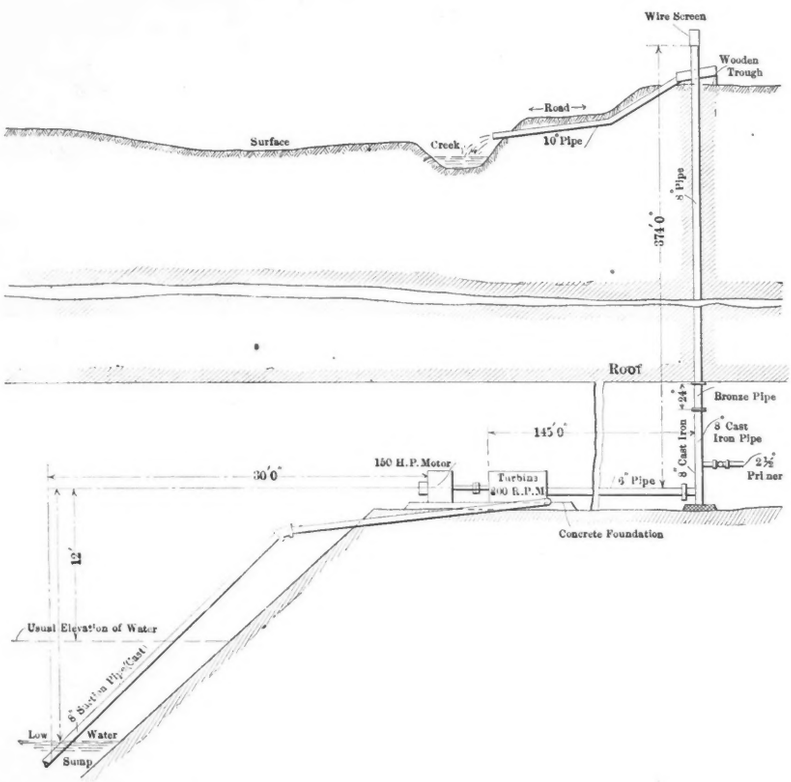


FIG. 3. SECTION SHOWING RELATIVE POSITION OF SUMP, TURBINE AND BORE HOLE

ly large so that all the fine particles suspended in the water have a chance to settle on the bottom. The seam has a general pitch of from 4 to 7 deg. The sludge is delivered at the upper end of the breasts, while the lower ends are closed with batteries and dry walls. When the water reaches the main sump it is decidedly clear. The difference in elevation between the sump and the flushing district is about 60 feet.

Besides the turbine pump, there is a 10x 18-in. duplex, horizontal, double-acting pump, directly geared to a general electric slow-speed 85-h.p. motor. This pump is located along the rope drive about 750 ft. south of the turbine pump room. The machine has a capacity of 600 gal. per min. against a 365-ft. head through a 10-in. bore hole to the surface. This pump runs only during the night shift, of about 12 hours and delivers 65,700,000 ft.-gal. during this interval of time.

Small portable electric pumps are also used. They are mounted on trucks with their circuits directly connected to the trolley feeders; these pumps are taken from place to place. A 4-in. suction pipe is generally used for these small pumps, while the delivery pipe is 3 in. The object of having these small machines is to collect local water to the main sump; they are also advantageously used in sinking slope and dip workings. The hight against which the pumps have to work varies from 10 to 50 feet.

The electric plant at the Maltby colliery consists of one compound-wound belt-driven dynamo, 555 volts full load and 270 amp., driven by a Ball tandem compound engine which runs at 200 r.p.m.; one Thomson Ryan dynamo, No. 620, 500 volts, 175 amp., directly connected to an 18x20-in. McEwen engine having a rated horse-power of 238 at 210 r.p.m. The energy for the turbine pump is mainly supplied by the latter dynamo. The size of the wire used is 4-3/0 rubber covered, which is let down into the pipe compartment of the hoisting shaft about 90 ft. from the power house. The wires are hung in the usual manner in the traveling way parallel to the tail rope haulage road.

It is a comparatively easy matter to calculate the quantity of water discharged from the ordinary reciprocating type of pump, since all the necessary data can be obtained in the pump room. But when dealing with a turbine pump, the usual methods of calculation cannot be applied. When the pump at Maltby was installed, one of the superintendents suggested that all the water pumped out in a given time be caught and weighed, but this method was found impracticable as it required bulky apparatus. I suggest two simple methods which are sufficiently accurate for practical use:

1. In this first method, the "velocity head," which is the only unknown quantity, can be directly determined. The velocity head h may be designated by the expression $\frac{V^2}{2g}$, which means that its value is that head which produces the velocity V at the discharge end, so that

$$h = \frac{V^2}{2g}; \text{ or } V = \sqrt{2gh},$$

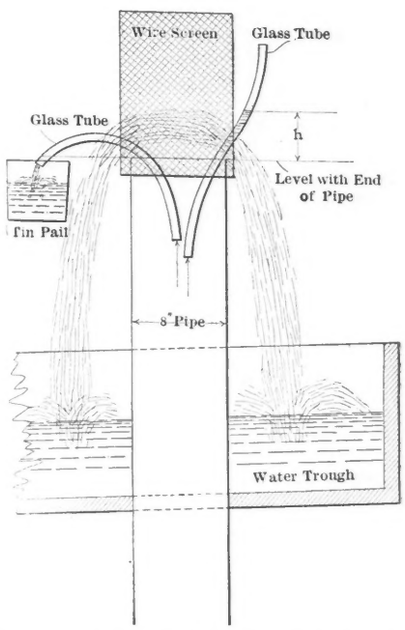


FIG. 4. APPARATUS FOR CALCULATING TURBINE DISCHARGE

in which g equals the acceleration due to gravity or 32.16 ft. per second.

To determine h, I have used a glass tube 3/10 in. in diameter, and slightly bent, as shown on the right-hand side of Fig. 4. The tube was held in the charge end in the manner shown in the sketch, and careful observations of h were taken at various parts of the section, the average of these observations was found to be 0.45 ft. Therefore, $V = \sqrt{2 \times 32.16 \times 0.45} = 5.38$ ft. per sec., and the quantity of water discharged per minute is $5.38 \times 60 \times 0.3489 \times \frac{1728}{231} = 842.5$ gal.

2. To check the method above described, I used another glass tube of the same diameter, with an easy curve, as shown on the left side of Fig. 4. The suction end of the tube was well fused so as to

eliminate the sharp edge of the cut. The discharge water through this tube was caught in a tin pail. The readings were taken in various parts of the discharging pipe so as to get the representative quantity of water passed through the glass tube.

Three tests of one minute each were made and the average quantity of water thus passed through the tube was found to be 9.80 lb. per min. In taking the sample of water, the discharging end of the tube was held practically level with the discharging pipe so as to avoid the action of the syphon as well as the pressure which would oppose the feed-flow of the water, if the discharging end of the tube were raised above the level of the main discharging pipe. By neglecting the internal friction of the tube as well as the friction due to the curve in the tube, and ignoring the temperature correction, the velocity of the flow of water through this tube may be calculated as follows: The quantity discharged per minute is 9.80 lb., and as 1 gal. of water under ordinary conditions weighs 8.355 lb., there are

$$\frac{9.80}{8.355} \times 231 = 272.15 \text{ cu.in. of}$$

water discharged. The diameter of the tube was 3/10 in. so that the velocity of the flow was found to be $\frac{272.15}{0.070696} =$ 3849.58 in. per min. The total quantity of discharge per minute, therefore, is

$$\frac{3849.58 \times 50\ 2656}{231} = 837.6 \text{ gal.}$$

The discrepancy between the two methods is $842.5 - 837.6 = 4.9$ gal., which may be due to the internal friction of the tube, provided the pump was delivering the same quantity of water when both observations were taken.

When delivering 837 gal. per min., the reading of the pressure gage attached to the pump was 170 lb., which is equivalent to a 392-ft. head; the normal suction head is 12 ft. Before the turbine pump was installed, it was thoroughly tested by the manufacturer; the results thus obtained are shown in Figs. 5 and 6. According to the efficiency curve shown in Fig. 5, the pump has an efficiency of 66 per cent.; so that the work done by the pump is

$$\frac{837.6 \times 8\ 355}{33000 \times 66} \times (392 + 12) = 130 \text{ h. p.}$$

Taking the cost of power including interest and depreciation on outlay, oil waste, repairs, pump runners, wages, etc., at 1.5c. per unit per hour, the cost of pumping may be expressed as

$$\frac{130 \times 1.5}{60} = 837 \times 404 = 0.000000961 \text{ c.}$$

per ft.-gallon.

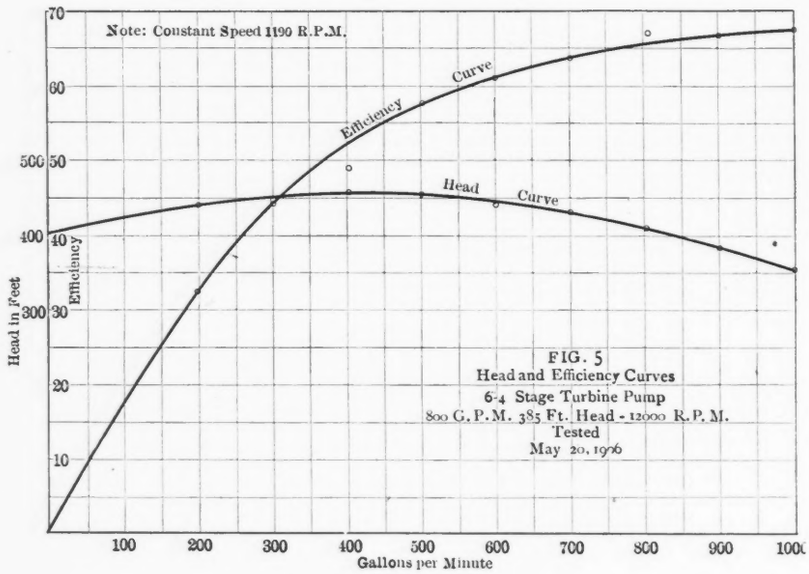


FIG. 5
Head and Efficiency Curves
6-4 Stage Turbine Pump
800 G.P.M. 385 Ft. Head - 1200 R.P.M.
Tested
May 20, 1906

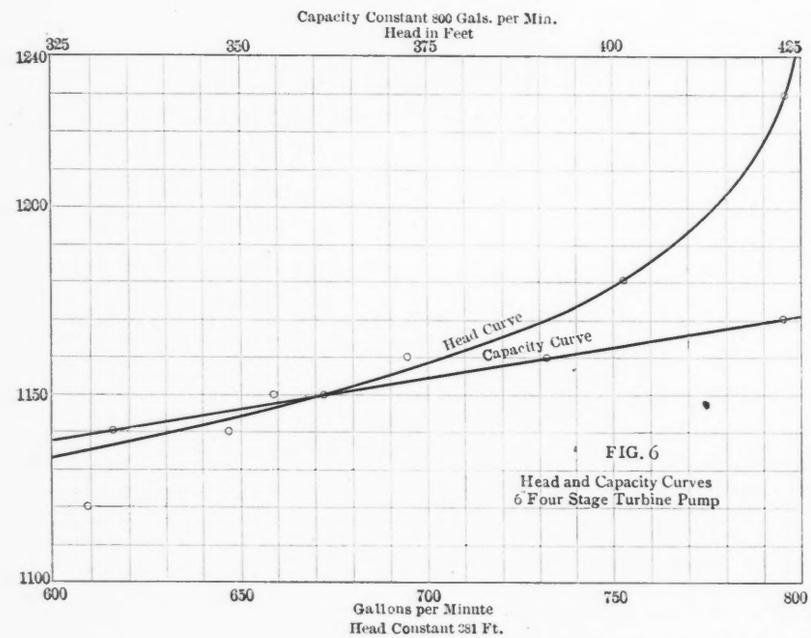


FIG. 6
Head and Capacity Curves
6 Four Stage Turbine Pump

Cost of Ventilation Per Ton of Coal Mined

Pennsylvania anthracite mines are, as a rule, decidedly gaseous, and to remove the gases thus generated in the workings, the fans must be run day and night regardless of whether coal is being mined or not; this causes the item of ventilation to be a constant source of expense. All air courses have to be carefully inspected before the miners are permitted to enter the workings. If there is a leakage along any airway the current will be short-circuited to the up-cast. To prevent such defects in the ventilation a force of bratticemen are employed to inspect brattice walls, adjust doors, build stoppings, etc.

In mines such as are operated in the Wyoming and Lackawanna valleys, the care given to ventilation is constant, for it is a matter of vital importance and safety to the men underground. The cost of maintaining an efficient ventilating system is high. The charges against ventilation are made up as follows: (1) Amount of steam used per month; (2) interest and depreciation on the fan and its drive; (3) oil, grease, waste, etc., used on the ventilating apparatus; (4) materials used in building the stoppings, brattices, etc.; (5) wages of brattice men and engineer. The total of all these items amounted to the following at one colliery:

$0.047 per ton of coal mined in 1902
0.049 per ton of coal mined in 1903
0.072 per ton of coal mined in 1904
0.082 per ton of coal mined in 1905
0.078 per ton of coal mined in 1906
0.081 per ton of coal mined in 1907

Pitch Mining in the Hazleton District

Every Tenth Breast Is Reserved in Order to Maintain Uniform Pillars in Each Seam, One above the Other

BY DELLWYN S. WOLFE*

The general direction of the Hazleton coal basin is east and west. The seams are all inclined, and in order to mine the coal it is necessary to proceed in a different manner to that used in flat workings. The different beds are of varying thickness, but the general method of mining is the same.

Fig. 1 shows a typical cross-section of the Hazleton basin. Fig. 2 is a portion of the map of the Gamma seam, showing the way the slopes, tunnels, gangways and breasts are driven. The beds lie in the following order:

	Feet.
Tracy, average thickness.....	4
Diamond, average thickness....	7
Orchard, average thickness.....	6
Primrose, average thickness.....	6
Mammoth, average thickness...	30
Wharton, average thickness.....	10
Gamma, average thickness.....	3
Buck Mt., average thickness....	8

With but one exception, the coal in the Hazleton district has been worked out from slopes; the exception being the Hazleton shaft colliery of the Lehigh Valley Coal Company.

The Mammoth being the most important seam in the basin, most of the slopes were sunk in this bed, as it allowed the companies to work out the coal without doing any great amount of rock work.

Timbering a Slope

In sinking a slope, the outcrop is uncovered and after the engines are set up and the tracks laid, the work of tunneling commences. On account of the depth of the basin, the slopes are made wide enough for a double track, so that time may be saved in hoisting a loaded trip up while the empty cars are going down.

The slopes are timbered from the outcrop to where the top is solid enough to support itself, and in the Mammoth the slopes are timbered all the way. A set of timber consists of a collar, two legs, a center prop and, until a good solid bottom is reached, a windsill. The collar is 13 ft. notch to notch, and is 7 ft. clear of the rail. The legs are set on 2½-in. outward batter. The timber used is pitch pine 14 to 18 in. in diameter, and unpeeled. The sets of timber are 5 ft. center to center, and are kept so by sprags, short pieces of 4- to 6-in. timber, which are cut to fit between the collars and between the legs and are nailed in place. After a set of timber is put up, laggings, pieces of 4-in. timber 5 to 6 ft. long, are placed back of the legs and above the collars, in order to keep any loose coal from falling in the slope (see Fig. 3). The rails in general use are 40 lb. and are laid on sills made of 6- to 8-in. timber.

Cars are used on slopes up to 40 deg. pitch. When the incline is more than 40 deg., the coal is hoisted by a gunboat, which is a sheet-iron car with covered top and one end open. The coal is dumped from the cars into the gunboat at the foot of the slope, and hoisted to the top where the gunboat dumps automatically.

After the slope is driven, gangways are started about every 300 ft. on the pitch. These are called first lift, second lift, etc., as they descend from the mouth of the slope. Hazleton No. 1 slope has eight lifts. The gangways are driven east and west from the slope and are driven to the boundary pillar line, if no faults intervene. The regular gangway grade is + 0.5 ft. per 100 ft. The gangway is driven 12 ft. wide and 7 ft. high. When the top is poor, or the entry is all in coal, the heading is timbered in the same manner as a slope, except that no mud sills or center props are used and the collar is only 7 ft. notch to notch. In the Mammoth seam, the main haulways are usually forepoled, i.e., the coal is so free in places that a working shield has to be put ahead of the last set of timber so the miner can work in safety. The forepoles are 6 to 8-in. timber, pointed at one end, and are rammed into the coal over the last collar and project 5 to 6 ft. beyond the last set of timber (see Fig. 4).

In the smaller seams where the top is good, but the coal free, props are put in on the high side of the gangway, and laggings are placed behind to keep the coal from running onto the entry. In other places, when the seam is on a heavy pitch, the post and bar is used. A prop is set up on the low side and a collar placed on it. The other end of the collar being in a hitch on the high side (see Fig. 5).

General Methods of Development

In the Mammoth seam the gangway is

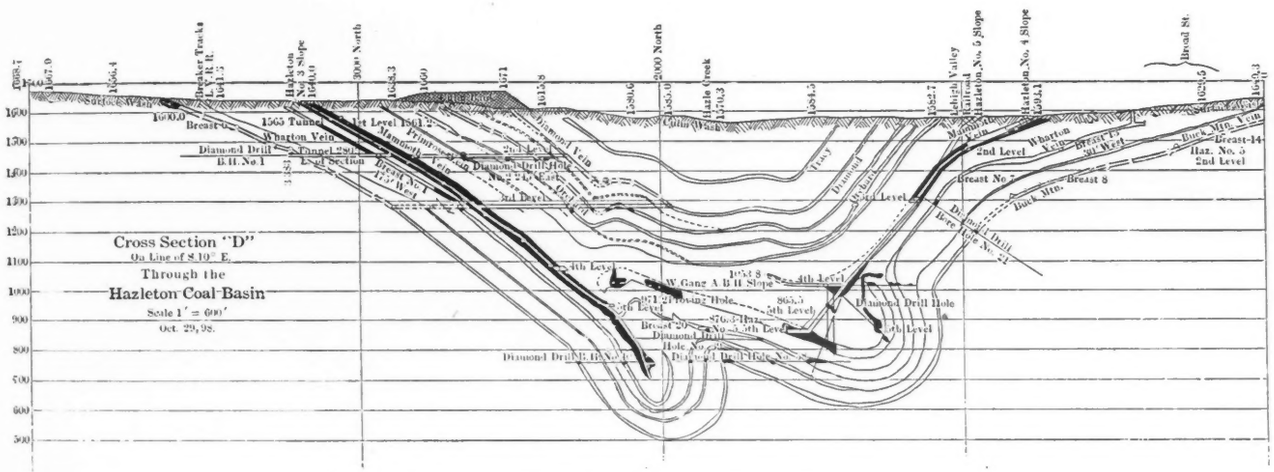


FIG. 1. TYPICAL CROSS SECTION OF HAZLETON BASIN

*Assistant engineer, Lehigh Valley Coal Company, Hazleton, Penn.

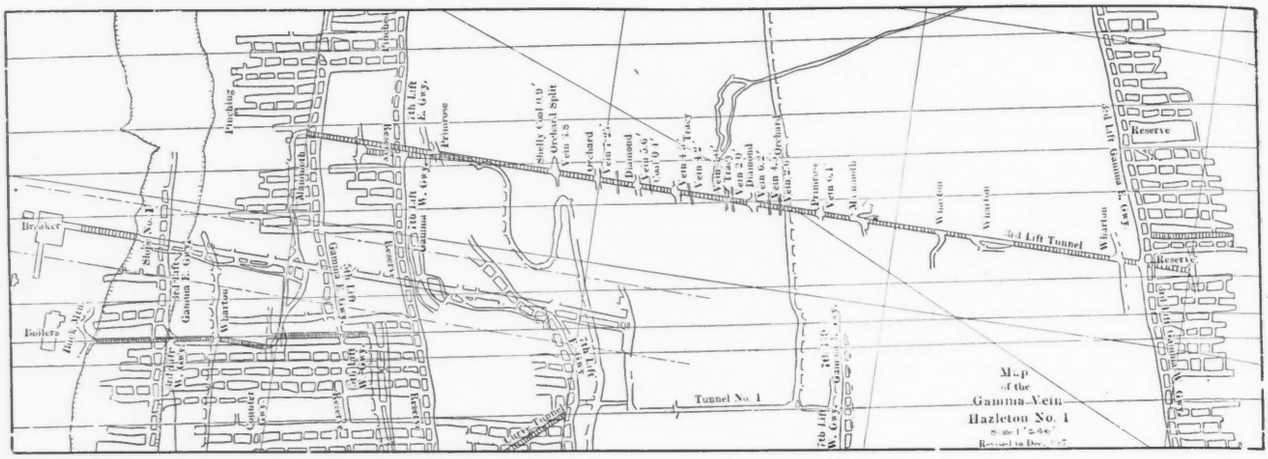


FIG. 2. PORTION OF MAP OF THE GAMMA SEAM

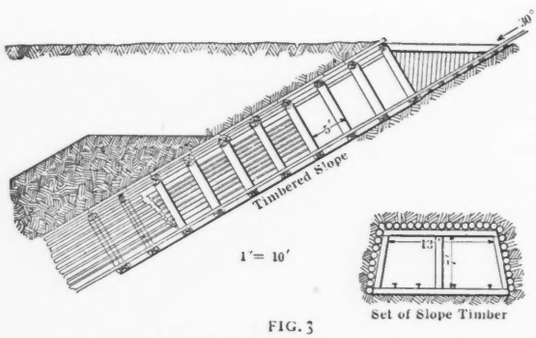


FIG. 3

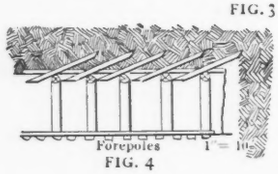


FIG. 4

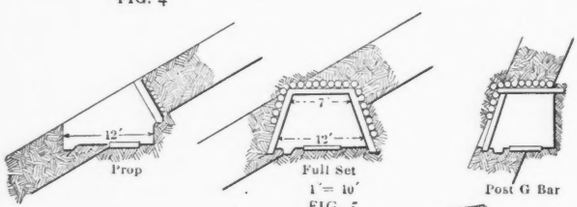


FIG. 5

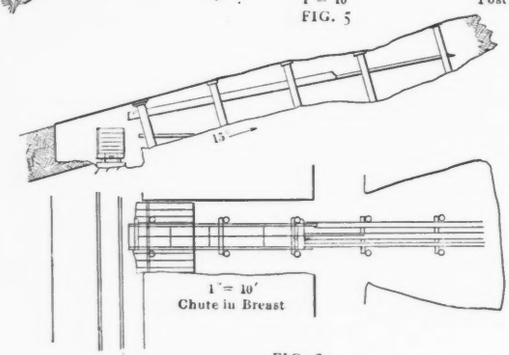


FIG. 8

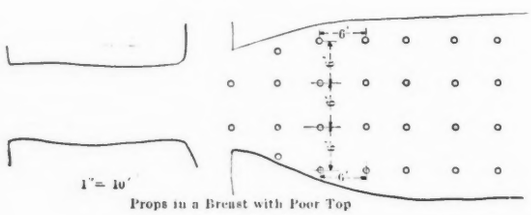
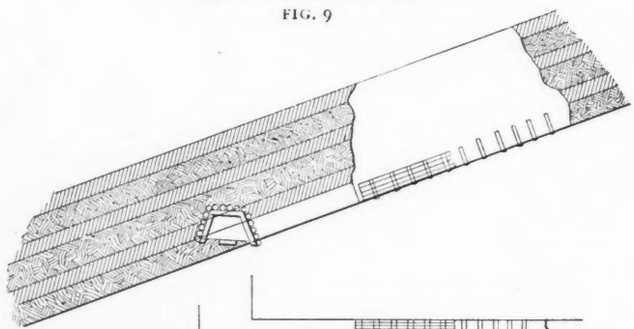


FIG. 9



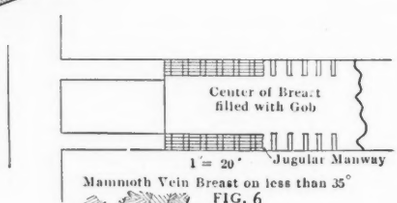


FIG. 6

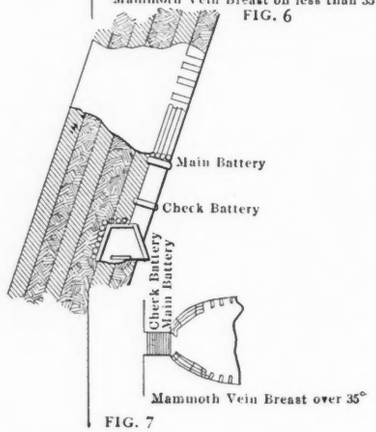


FIG. 7

generally driven on the bottom bench. On pitches less than 35 deg., two chutes are driven, one on each side of the breast. These chutes are generally about 6 ft. wide and 24 ft. long. At the end of the chutes the miner works up to the top rock and opens the whole seam. The breasts are 24 to 30 ft. wide. After the seam is opened out, jugular manways are started at the end of each chute and carried up each rib of the breast. In actual mining, a 6-ft. cut is first made in the bottom bench, and the manway afterward extended. Then the top coal is blown down by firing holes drilled up from the bottom bench. The coal is run down the manways to the gangway and the slate and bony coal is then left in the middle of the breast (see Fig. 6).

On pitches greater than 35 deg. only one chute is driven; this is carried up about 24 ft. and a main battery is built at the end. A check battery is usually constructed about 10 ft. from the gangway. After the seam is opened out, the jugulars are carried up each rib of the breast from the main battery. The coal as it is mined is left in the breast in order to keep a place for the miner to work in. The surplus coal is thrown into the jugulars, and after the chute is full, is loaded out (see Fig. 7).

After the Mammoth seam is nearly worked out, tunnels are driven north and south from the gangways in the various lifts of this bed to tap the overlying and underlying seams. It is customary to drive but one tunnel on a lift, and this one is started about 300 or 400 ft. from the slope in order to leave sufficient room for a turnout. As the seams of coal are cut in the tunnels, gangways are started right and left and driven ahead.

Working the Breasts

The ventilation is carried on by chutes which are driven up the pitch at about 50 ft. centers and connected by stump headings. The chutes are 10 ft. wide and 24 ft. long. The stump headings are 6 ft. wide. The breasts are started from the high side of the stump and are driven 24 ft. wide, with headings every 60 ft. As near as possible, every tenth breast is reserved, or rather not worked, in order to keep uniform pillars in each seam one above the other, so that any squeezes or falls may be localized, and the surface protected.

On pitches up to 30 deg. sheet iron is used to convey the coal from the face of the breast to the loading platform at the gangway. When the bottom is regular, sheet iron is laid on the bottom rock and is carried up the middle of the breast. Generally two widths of sheet iron are used. When slate occurs in the seam, it is picked out and thrown along the sides of the breast and on each side of the sheet iron. When the bottom is irregular, a chute is built and carried to the face. The props are set up at 10-ft. intervals and about 4 ft. apart; cross pieces are nailed on to these props. On these cross pieces three planks are nailed, one in the center and one on each side; sheet iron is fastened to these planks and the chute is ready for use. Whenever it is possible the chute extends to the gangways and is high enough to dump coal into the cars. The miners keep a regular pitch on the chute by raising or lowering the cross pieces (see Fig. 8).

Timbering the Working Places

The timber in a breast is governed by the conditions of the top. If the top is good, only the chute props are put in; if it is poor in places, these districts are timbered by setting props every 6 ft. (see Fig. 9). In setting props, the miner first digs a hitch in the bottom rock. The prop is then cut, allowing for a cap piece of 2-in. plank about 20 in. long. This is placed on top of the prop and a wedge driven in between the cap piece and the roof.

When a pitching breast strikes a flat, a buggy road is put in. When the breast strikes the pitch again, a platform is put in and the coal loaded into the buggy and buggied across the flat and dumped into a chute which carries it to the gangway. On light pitches a gravity buggy is sometimes used; a snatch block is fastened at the face of the breast and the loaded buggy pulls the empty car up. When the lift is too long, counter gangways are driven and the coal is dumped in a counter chute and loaded on to the main gangway.

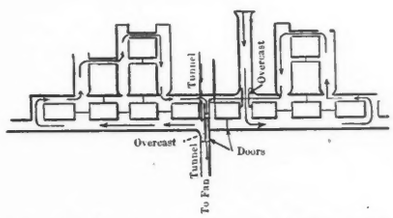


FIG. 10. GENERAL SYSTEM OF VENTILATION

On pitches of 35 deg. and over, a main battery is built at the high side of the stump. This is made by setting 4 props in the center of the breast. Two props are set about 4 ft. apart, then another prop is set up on the outside of each one so that room is left for a 2-in. plank between. Two 2-in. planks are nailed to the bottom of the props, and from there to the roof, laggings are put in to hold back the coal. The planks are cut out so that when the breast is to be loaded, an opening is available for the coal to come through while the lagging holds back the main body of coal.

Props are set above the battery, every 6 ft. and 3 ft. from the rib; between these are lighter timbers called relief props. Planks are inserted in the opening between the battery props and carried to the roof; these planks are nailed to the manway props, thus making an inclosed space with manways on each side. One is used as a traveling-way by the miners and has steps, which are made of laggings laid against the prop on one end, and hitched in the rib on the other. The other manway is called a blind-manway; it has no steps and is used as a chute for coal. The space inside the battery and manways is filled with coal as the breast is worked. After the breast is finished the main battery is opened and the coal loaded out.

Robbing the Pillars

After a gangway has been worked to the boundary and all the breasts are exhausted, robbing is then started at the face of the gangway and all pillars are drawn back to the tunnel. Where the top is good the rib is skipped to the face and the pillars are then brought back. When the top is poor, chutes are driven in the pillars to the faces of the breasts, and the pillars are brought back through the chute. In either case, as the pillars are being robbed, props are set up 6 ft. apart, and at 20 ft. intervals on the pitch, in order to protect the miner from any falls and to keep the rock out of the coal.

In ventilating the workings the gangway is usually the intake. The return air coming back to the tunnel through the headings to the chute and through an overcast to the door in the tunnel. Where the seam has an opening to the surface, this opening is used as an inlet and the air is carried across the stump heading by means of an overcast and enters the gangway inside of a door.

Cost of Haulage in Anthracite Mines

The tractive force used in anthracite mines depends directly upon the condition of the haulage roads. Electricity has practically taken the place of mules in many mines. In one mine where mules handled the coal, the cost of transportation was from 9 to 11c. per net ton mile. In the same mine, after the installation of electric motors, the cost of transportation was reduced to 2.8 to 3c. per net ton mile. In gaseous workings, compressed-air haulage systems are often installed, but on account of unpreventable leakage along the air lines and the inflexibility of the system, the cost per ton of handling the coal is sometimes as high as 6.5c.; in most mines, however, where the grade is not too heavy, the cost per ton mile does not often exceed 3.5 cents.

During the years 1900 to 1906, inclusive, 3538 persons lost their lives in and about the anthracite coal mines of Pennsylvania. These casualties left 1908 widows, and 4475 orphans under 14 years of age.

Operation of the Sayre Colliery, Pennsylvania

Recent Ideas Have Been Embodied in Constructing the Breaker, Which Handles the Output Previously Prepared at Three Other Plants

BY H. J. HEFFNER*

The new Sayre breaker of the Lehigh Valley Coal Company located one mile northeast of Mt. Carmel, Penn., was built to handle the coal previously prepared at the Mt. Carmel, the Sioux, and the Bellmore breakers, the purpose being to concentrate the coal from several mines and prepare it for the market at one place. The location selected for the breaker had many natural advantages that permitted economy in construction. The natural slope of the ground was favorable both to haulage and drainage.

In providing concrete foundations for the various buildings, engines and boilers, the stone necessary was available in the immediate vicinity. The concrete forms for the walls were built of plank which were used again and again until worthless. The mixture was placed in these molds as follows: First, stone of various sizes was placed to a depth of from 6 to 12 in.; then, grouting was filled in, being mixed in the proportion of one part cement to two parts sand; this mixture was made thin so as to thoroughly fill all spaces between the stone.

Framework of the Breaker

The main framework of the breaker was built of 12x12-in. Southern yellow pine timber; white pine was used in building the jig tanks and for hand rails around the machinery. The longitudinal and sectional bracing timbers were 5x10-in., 5x12-in. and 6x12-in. yellow pine. These braces were secured in place with ¾-in. bolts, each having a ¾-in. cast washer under the head and nut. The framework of the breaker was fastened together wherever possible, by cast-iron timber brackets in preference to mortise and tenon joints. Each bracket was bolted to the timbers, thus tying the framework securely, and making a more solid support for the machinery. About 1500 M. ft., board measure, was used to complete the structure which is well lighted and ventilated.

Painting

Both the interior and exterior of the breaker building is covered with fireproof paint which was applied by compressed air, being forced through a ¾-in. rubber hose on the end of which a spray was attached. The paint was received at the colliery barreled in powdered form and was mixed with cold water in a special mixing machine, which the paint manufacturers furnished. The inside was painted white and the outside black. The time consumed by four men in painting the breaker complete, was about four weeks.

Heating

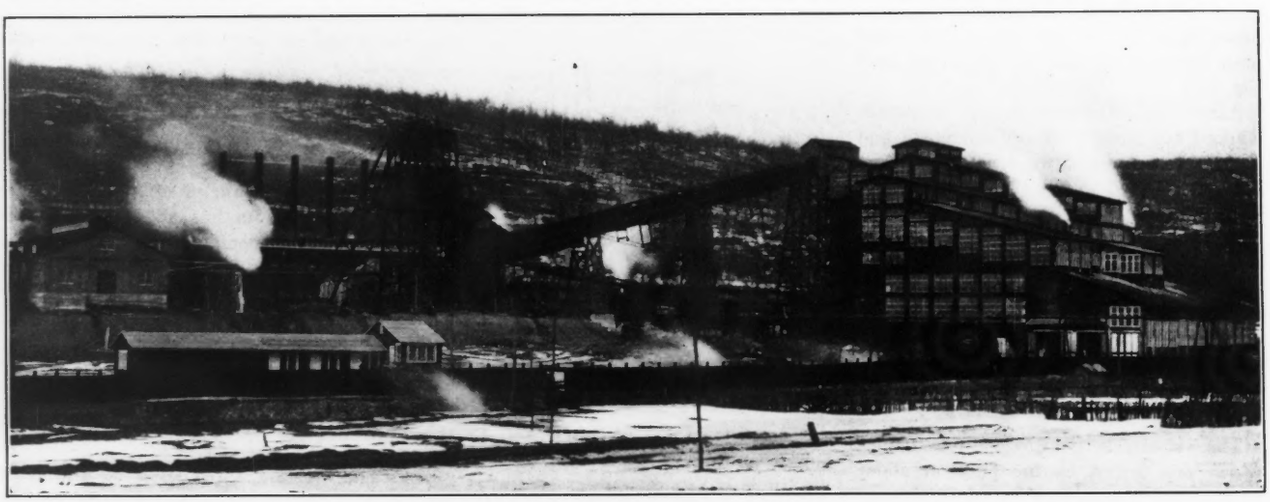
A series of twelve old cylinder boilers about 30 ft. long were placed on concrete piers, underneath the breaker, and are used for heating the building. The exhaust steam from the breaker and jig engines is conducted through the boilers, then through the building and out through the breaker roof, where the pipes are fitted with exhaust heads.

Fire Protection

The breaker is well protected against fire on the outside by numerous fire plugs located near the building; the inside is protected by a complete system of fire piping and hose. A well drilled and thoroughly equipped fire company composed of the colliery employees adds materially to the extensive precautions taken by the owners to reduce fire risk. The breaker is equipped with electric signals throughout for the stopping and starting of machinery.

The Water Supply

The water used for washing the coal is received from a reservoir located about a half-mile north of the breaker on the side of a mountain and about 60 ft. vertically above the top of the breaker. The water is pumped into this reservoir from the first level of the shaft by a 24x42x14x48-in. Worthington compound-condensing pump, the column being a 14-in. cast-iron pipe to the surface, and a 14-in. Wyckoff wood pipe from here to the reservoir. By regulating two valves, the water can be either pumped into the reservoir or can be turned directly into the breaker. The water pipes throughout the building are made of cast iron, owing to the acids contained in the mine water used for washing the coal. Over each shaking screen there is a 2-in. perforated pipe, having ⅛-in. perforations spaced 2 in. apart; each jig also has a 2-in. pipe. The water used for washing the ashes from underneath the boilers in the boiler house is taken from the reservoir.



GENERAL SURFACE PLANT AT THE SAYRE COLLIERY OF LEHIGH VALLEY COAL COMPANY NEAR CENTRALIA, PENN.

Machinery

The coal-cleaning machinery consists of the following kinds:

*Assistant engineer, Lehigh Valley Coal Company, Centralia, Penn.

35 Lehigh Valley standard shaking screens.
32 Lehigh Valley standard 4 ft. jigs.
2 Spiral separators.
1 set 33½ x 46 in.-main crusher rolls.
1 set 26 x 36 in.-main crusher rolls.
2 sets 30 x 36 in.-re-breaking rolls.
2 sets 23¾ x 30 in.-No. 6 bone rolls.
4—5 x 12 in.-coal conveyer lines.
1—6 x 16 in.-bone conveyer line.
1—6 x 16 in.-rock conveyer line.

All the machinery in the breaker, excepting the 32 jigs, are driven either direct or from counter shafting by a 21x31 x36-in. cross-compound engine. This engine has a 120-in. fly-wheel belt pulley 40 in. wide, from which a 36-in. 10-ply rubber belt is run to the main driving shaft; the pulley on the main shaft is 80 in. in diameter and 40 in. wide. The main shaft is 8⅞ in. in diameter and is supported on concrete piers which are about 5 ft. above the surface; the idea in setting the shaft so near the ground is to remove the excessive strain from the main framework of the breaker. The pedestals supporting the shaft are fitted with adjusting wedges so that if the shaft gets out of line it can be readily adjusted by tightening or loosening the wedges which are controlled by set-screws.

On the main shaft are 17 rope sheaves, of various sizes; these 1½-in. rope drives run from this shaft to the various counter shafts and to such machinery as is connected direct. The jigs are driven by a 12x18x36-in. tandem compound Corliss engine, which sets alongside the engine driving the other breaker machinery, and from which six 1½-in. ropes run to a counter shaft in the top of the breaker.

The coal from the Sayre mine is hoisted up a shaft from the first and second levels on self-dumping cages; the cars are emptied into a chute which is connected with a traveling bucket conveyer running on a pitch of 3 in. per ft. for a distance of 250 ft.; the speed of travel to a point in the top of the breaker where the coal is discharged, is about 100 ft. per min. The run-of-mine coal which is dumped at the top of the breaker goes into a cast-iron chute 4 ft., wide and which leads to two main shaking screens at the top of the building. The coal, after passing over the two large screens, starts on its preparation by machinery.

The output from the Sioux No. 3 and No. 1 mines, which are one and two miles west of the Sayre breaker, respectively, is hauled overland by steam locomotives to the head of the shaft, from which point it is hoisted and delivered to the breaker in the same way as the coal from the Sayre mines. The coal from the Sioux mines will eventually be hauled underground by electric motors to the second level of the Sayre shaft, thus doing away with surface locomotive roads. The breaker is at present preparing about 1500 tons per day of 9 hours, but will eventually increase this capacity.

Preparing the Coal

The two shaking screens in the top of the breaker are 5 ft. 9½ in. wide and 8 ft. 8 in. long, with 6½-in. round meshes; one end of the shaker is supported by a chain, while the other end has two 16-in. diameter car wheels underneath it. These screens take the place of the platform bars. The coal which passes through the 6½-in. mesh on the main screens is conducted by chutes and automatically fed into the mud screens; from these latter separators the steamboat coal goes direct to the picking floor, while the broken coal runs into the broken coal elevators, which raise it to the top of the two spiral separators, from which point it goes to the picking floor. The sizes smaller than broken run to the foot of the main elevators, where they are raised to a point high enough to allow the coal to be sized before going to the jigs.

The screens to which the main elevators deliver the coal are installed in sets of four, one vertically over the other, in this way making all sizes from egg to boiler fuel. Most of the shakers have double decks so that one will make two sizes of coal. After being screened, the coal passes to the jigs where it is automatically cleaned. After leaving the jigs the coal is given a final inspection by hand picking, then is re-sized by small shaking screens before passing to the pockets, from which it is loaded into cars ready for market.

The coal which passes over the main screens runs onto picking tables in the head of the breaker; the bone and rock are here picked out. The rock is pushed into a rock chute and goes to a pocket on the ground floor, from which point it is loaded into mine cars and is hauled by a steam locomotive to the rock dump, one-half mile west of the breaker. The bone coal is ground to smaller sizes for the purpose of separating the coal and slate; this product is then sized over shaking screens and passes on to the jigs, where the slate and bone are removed. The coal is inspected and again sized before going to the pockets for shipment.

The pure coal, which passes over the main picking floor, is carried to the crusher rolls and broken to steamboat and smaller sizes; no lump coal is made at the Sayre breaker. The pure coal, after being crushed, is carried to the steamboat and broken screens; these two sizes are run direct to the pockets, ready for shipment, while the sizes smaller than broken coal run by gravity to a point in the lower part of the breaker, where the clean coal elevators hoist it to such an elevation that it will slide over the clean coal screens hung in the center of the breaker. The coal, after passing over these latter screens, is conducted to the screens in front of the pockets, over which it is carried for final sizing. The jigs in use at the breaker are known as the Lehigh Valley Coal Company's Standard 4-ft. jigs and are capable of removing from 90 to 98 per cent. of the impurities contained in the run-of-mine coal.

All chutes in the Sayre breaker that carry water are built of 2-in. plank covered with water-proof roofing. The trough carrying the jig sludge from the breaker is also built in this way; the sludge being carried a distance of 3000 ft. to a mine opening, where it is discharged and the culm used to fill up abandoned workings; the water is released to the live workings of the mines, from which it is again pumped to the surface.

The Guibal Fan

The Sayre Colliery is ventilated by a 20-ft. Guibal fan driven by a 16x32-in. Corliss engine, and is inclosed in an absolutely fire-proof house. The fan is reversible and can be used either as an exhaust or a blower; the change is effected by regulating the doors in the air-lock and shutting the swinging door in the air-stack. The fan house is one solid mass of concrete, excepting the roof and the window frames. The windows are made of wire glass ¼ in. thick, so as to give them additional strength.

The Engine House

The Sayre shaft-engine house is a one-story brick building 52x104 ft., with steel roof trusses and covered by 1-in. boards and fire-proof roofing. This building contains one pair of 30x48-in. first motion, balanced slide-valve simple engines, with a double 14x10-ft. conical cast-iron drum, grooved for 1⅝-in. rope; one side of the drum is loose on the shaft, and is controlled by a friction clutch. This engine is used for hoisting coal from the No. 3 level, a distance of 600 ft. There is also a pair of 26x48-in. first motion piston-valve engines with a 10x8-ft. conical cast-iron drum similar to the one on the engine previously mentioned. This engine is used for hoisting coal from the first and second levels, a distance of 235 and 437 ft., respectively.

The reverse lever, friction clutch and brake of both these engines are operated by small steam engines set between cylinders and also below floor level; they are operated by levers at the engineer's stand. Hand-power brakes also form a part of the equipment. The large engines each have an auxiliary steam throttle, so that in case one machine refuses to close, the engineer can close the other, in this way reducing the danger of an over-hoist.

The electric-generating plant of the colliery is also located in this building, and consists of a 17x28x20-in. engine, direct-connected to a 175-kw. 250-volt direct-connected generator, which supplies electricity to three 7½-ton motors inside the mines. The feed wires are carried down the shaft to the first and second levels, from which point they are strung into the various gangways.

Oil House

The oil house is a two-story brick building 22x22 ft., with a frame roof covered with fire-proofed roofing; the first floor is cement, while the second story is frame. The various grades of oil, lamp

cotton, etc., are kept in this building and given out each morning to the employees. The oil tanks are made from old cylinder boilers, and have a capacity of about 250 gal. each. They are set on a concrete pier about 18 in. above the floor, the oil being delivered in barrels to the second floor, where it is tapped and run into tanks from which it is later drawn for use.

Other Buildings

The office and warehouse is a one-story frame building, the former being 14x37 ft., while the warehouse is 84x29 ft. The scale beam for the loaded cars from the breaker and for the retail coal is located in this office, and all coal leaving the breaker, either by rail shipments or by team, is here weighed.

The carpenter, blacksmith and machine shop is a frame structure, one story high, with a corrugated iron roof. In the carpenter shop old mine cars are repaired and new ones put together. This part of the building is equipped with both a circular and a band saw, while the machine shop is equipped with a small planer, an 8-in. pipe cutter and threader, a radial drill press, a stationary drill press, an emery wheel and lathe, also a bolt cutter and grindstone. The machinery in the shop is run by a 10x16-in. single engine connected to a counter-shaft by belting.

The head-frame is made entirely of steel, with the exception of the wooden guides and floor. The frame is 85 ft. from the top of the shaft to the center of the sheaves at the head. Four 10-ft. rope sheaves are set in this frame, and carry the ropes from the hoisting engines to the cages.

The boiler house is a brick building 161x42½ ft. with a 34x32-ft. wing on the west end for a blast fan, feed pumps and water heater. The roof is built with steel trusses covered with lead-dipped corrugated iron. In this house are seven sets of water-tube boilers of 300 h.p. each, making a total of 2100 h.p. The boilers are equipped with shaking grates, and the ashes, which are washed out by water, are carried to a bore hole about 100 ft. south, where they are used for filling in abandoned workings.

The air blast for these boilers is conducted beneath the floor at the back end of the boilers by means of a 5 ft. 4 in.x 4 ft. 7 in.-concrete air duct; the blast is delivered at a point directly under each grate. A sliding damper attached to each 18-in. branch pipe regulates the amount of air.

The feed water is delivered from the water main into a suitable feed-water heater set in the fan room; the exhaust steam from the shaft fan, electric dynamo, blast fan, feed pumps and boiler-fuel conveyer engines is turned into the heater and raises the temperature of the water from 190 to 210 deg. The steam made by each set of boilers is conducted from the steam drum by a 7-in. pipe to an 18-in. header pipe at the back end of the boilers; from this header pipe steam is distributed to the various engines and pumps around the colliery.

Inside Workings

The inside workings at the Sayre Colliery are connected with the surface by a six-compartment shaft 41 ft. 2 in. long by 12 ft. 6 in. wide; two openings of the shaft are used to hoist coal from the first and second levels; two to hoist coal from the third level; a fifth opening is for pumping from the third level, while the last compartment is connected with the 20-ft. Guibal fan on the surface, and serves as the main airway for mine ventilation. The shaft was started in November, 1903, and finished in January, 1907.

At the first level landing the cars are delivered to the east side of the shaft by an electric motor, and are then dropped to the cage on a 2-per cent. grade, the loaded car bumping the empty one off the cage; the empty runs by gravity to the foot of an empty car plane where it is hoisted by a 25-h.p. electric motor; from the head of the plane the car again runs by gravity to the empty car siding, from which point the motor pulls the empty trip to the interior partings.

At the second level the cars are delivered to the shaft by the electric motor and rest against a car stop; this latter is built on a 4.69-per cent. grade, and is located about 20 ft. east of the shaft; at the proper moment, the operator in charge pulls the lever and the car is released at sufficient speed to dislodge the empty from the cage.

The different seams at the Sayre Colliery are worked on both the north and south dips. Two large rock tunnels have been driven at this mine connecting the north workings with those on the south dip. Practically all the haulage in the mines is accomplished by electric motors, there being only seven mules used inside the mine.

Early Preparation of Anthracite Coal

A study of the industrial progress of our country shows that the anthracite-coal industry of Pennsylvania has contributed some interesting chapters to our early history. None of the problems that confronted the pioneer operators was of greater importance than the sizing and preparation of the coal produced.

Up to 1830, and we have reason to believe that as late as 1835, the production consisted of "run-of-mine," preparation being then unknown. Early statistics are so unreliable, that it is impossible to say definitely when active preparation did commence; but the advancement made in the line of preparation took place at a later date than is generally supposed. This is verified by the descriptions given by some of the early operators, and by the recorded testimony of witnesses in various lawsuits tried years ago.

AN EARLY TYPE OF SCREEN OPERATED BY HAND-POWER

From an examination of such testimony, it appears that breakers first came into use about 1856; the term breaker, prior to that time, implied the use of any device for smashing the coal; the present-day coal breaker, with its tons of machinery and mechanical devices for sizing and preparing the coal, thus received its name. A further verification of this belief is furnished by the wording of some of the early agreements or leases made between landlords and tenants.

It is not generally known that hand power was at one time the motive force for revolving the screens and for sizing the coal. The accompanying illustration shows a screen turned by hand, at a small plant, which conducted a local business a few years ago. It is impossible to pass a curiosity of this sort without stopping to examine its construction and then contrast the methods of the early days with more modern practice.

Concrete Underground Mine Stables

Concrete Barns Costing $50 per Mule to Construct, are Eventually Cheaper and Safer Than the Old Style Wooden Stable

BY JOHN H. HAERTTER*

The announcement that one of the mining companies of the anthracite field will install mechanical equipment for haulage purposes, seldom fails to inspire an article which describes at length the exit of the mine mule. These articles have appeared on numerous occasions and have impressed many who are unfamiliar with mining methods, that the mine mule will soon be a relic of ancient mining methods. The impression is wrong, for while mechanical haulage has brought about an appreciable decrease in the number of mules in and about the anthracite collieries, we still find these faithful animals contributing much of the energy or power consumed in the underground transportation of the coal from the working faces to the foot of the hoisting shaft or slope; or to a station or turnout where the haul is taken up and completed by mechanical means.

While mules remain, they must be properly cared for, and although they have decreased in number, the efforts of those in charge to better provide and care for them, have correspondingly increased, as is evidenced from descriptions of some of the improved methods of constructing an underground stable, as well as of the care and treatment of the mine mule.

Locating a Mine Stable

One of the principal considerations to be observed in the selection of a location and the construction of an underground stable for mules is that of guarding against fire. It should be built fireproof, both for the protection of the mules and the mine. Many of the destructive fires in the anthracite field, as well as elsewhere, have had their origin in the pump house, or in the underground barn, where wood furnished the material for construction. Less than a year ago, a serious fire had its origin in the barn of the Woodward mine near Wilkes-Barre, Penn., and was not extinguished until 41 of the 48 mules in the barn had been suffocated.

Sanitary Stables

The next thing of importance is to make the quarters sanitary. This part is often neglected and little attention is frequently paid to it. A study of the sanitary conditions of the barn begins with the selection of the stable location as to drainage, and ends with the construction that will make it convenient and easy for the barn-boss to keep it in a clean and healthy condition.

For the reasons explained, and from past experiences, coupled with a study of the conditions upon which depends the life and greatest service of the mine mule, healthy, substantial barns constructed of concrete and iron, are replacing the former wooden structures. Some of the more recently built stables to be found at many of the anthracite collieries are built to embody all the precautions related above, and many of them are models after which it would be well for others to pattern.

All conditions were previously studied, and the methods of construction made suitable to meet these modern ideas, in building the barns recently completed by the Lehigh Valley Coal Company, at its Seneca and Heidelberg collieries near Pittston, Penn., and I doubt whether a barn exists in any of the anthracite mines which will surpass or even equal these in construction, general arrangement or appearance.

The Seneca Barn

The usual practice has been to locate the barn in close proximity to the hoisting shaft or slope, to allow of quick transportation of the mules from the inside to the surface when their loss becomes possible through danger from fire, water, caves, etc. This rule has been, and is still, almost universally followed where conditions are favorable. There are now, however, many cases where other conditions have made it advisable to depart from the usual custom, one of which is created by the abandonment of several breakers and hoisting outlets, and the resulting necessary transportation of such coal, which then becomes remotely situated from the new hoisting outlet. This condition existed at the Seneca colliery, and the barn was located at a point central to the working territory, rather than in close proximity to the shaft, although fortunately, the distance from the barn to the outlet is not so much in excess of that usually desirable.

Going down the Seneca shaft to the Marcy seam and toward the barn, we come first to the concrete house in which is kept the Seneca hospital car (Fig. 7);

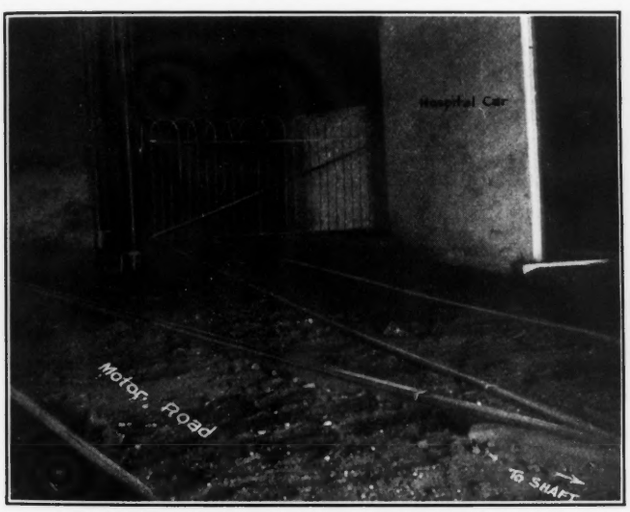


FIG. 1. ENTRANCE TO UNDERGROUND CONCRETE MULE BARN AT SENECA COLLIERY, PITTSTON, PENN.

FIG. 2. CONCRETE STALLS IN UNDERGROUND MULE BARN, AT HEIDELBERG COLLIERY, LEHIGH VALLEY COAL COMPANY

*Engineering department, Lehigh Valley Coal Company, Wilkes-Barre, Penn.

then to the shoeing room, harness room, and feed room in the order named. These are all absolutely fireproof, wood having been entirely discarded in their construction. The dimensions of the rooms which belong to the barn are shown in Fig. 7. In the harness room, a sheet-iron closet contains material and tools for repairing harness as well as medicines, salves, etc., for treating sick or injured mules. Iron hooks in the walls hold new harness and collars, while an offset in the concrete forms a shelf which is convenient for many purposes. A heavy sheet-iron door which is kept locked, and for which only the barn-boss carries a key, forms the entrance.

Details of the Seneca Barn

The feed room 36 ft. 2 in. long by 10 ft. 3 in. wide in the clear, furnishes one of the most interesting and useful parts of the barn. The floor and walls, as are those of all the other rooms, are well finished in cement. The feed room is upon entering and examining the feed room of the Seneca barn. The remaining space in the room is for storing baled hay which is handled through openings shown in Fig. 7. The bottom of the openings are about level with the top of the mine car so that the bales are easily handled. Provision for the proper ventilation of the feed and harness rooms was made by stopping the walls at about 2 ft. from the (see Fig. 5). Reference to Fig. 8 will show clearly the dimensions.

The location is an old barn chamber which for hight, pitch, etc., was admirably adapted for the present stable, but unfortunately was not as straight as was desired, having been driven previous to the time the present operators came into possession of the colliery ,and when little attention was given to driving the chambers on line.

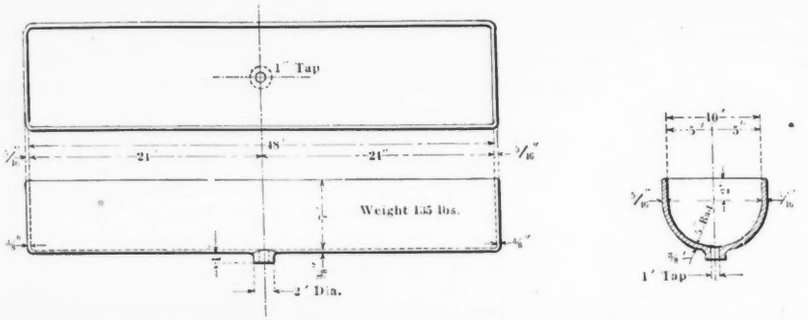


FIG. 3. CAST-IRON WATER TROUGH FOR MULE BARN, LEHIGH VALLEY COAL COMPANY

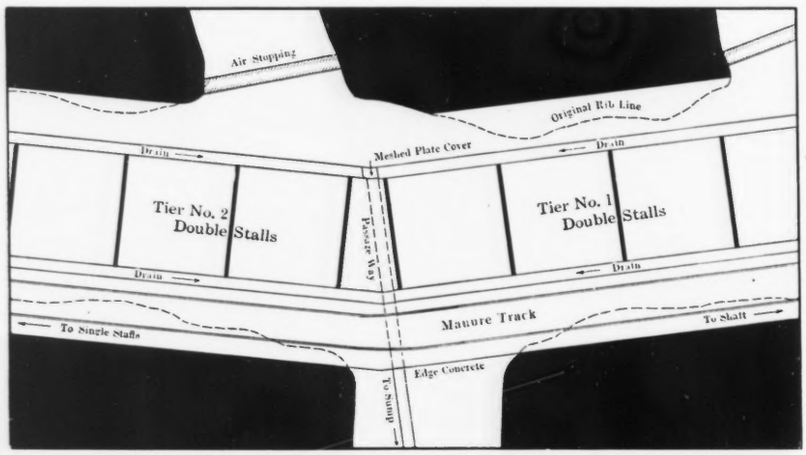


FIG. 4. PLAN OF STALLS AND MANURE TRACK

Angles in the direction were taken advantage of, as shown in Fig. 4, by placing a passageway between tiers. The barn consists of four tiers; starting at the feed end and walking through the barn room, tier No. 1, 70 ft. long, contains 17 double stalls; tier number 3, 40 ft. long, 4 double stalls, and tier number 4, or the end tier, 40 ft. long has 7 single stalls, a total of 28 double and 8 single stalls, comprising 320 ft. in length; when 20 ft. is added for passageways, the total length of the barn is about 340 feet.

Fireproof Construction

Except for the planks laid on the concrete floor of the stalls, the stable is entirely free from wood and its construction may therefore be regarded as fireproof. Six-inch cast-iron pipes form the corner

shown in plan in Fig. 7 and in elevation in Fig. 6. In one corner is the feed bin of concrete construction, 3 ft. 6 in. wide by 24 ft. 6 in. long, a compartment, 3 ft. 3 in. long by 3 ft. wide, which contains bran, being separated from the longer compartment, 20 ft. 3 in. long by 3 ft. wide, containing corn and oats, by a solid concrete partition 3 in. thick. The bin is covered with three heavy sheet-iron doors, to the straps of which are attached ¼-in. wire ropes operating counter weights for raising and lowering the doors (see Fig. 6). The bin as constructed is impenetrable by rats and for that reason will soon show a great saving, in fact a saving is already noticeable though the barn houses have been in use but a short time. Those who have carefully noticed the feed scattered about in the old-style feed rooms built of wood will readily see that a saving must result.

The fact that concrete construction is most advisable becomes at once apparent

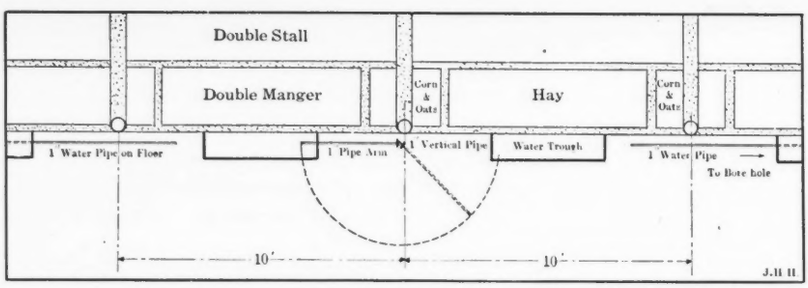


FIG. 5. PLAN SHOWING ARRANGEMENT FOR DOUBLE STALLS AND METHOD OF SUPPLYING WATER TO TROUGHS

top rock, and imbedding in the walls and inserting in holes drilled in the roof the 1-in. gas pipes as shown in Figs. 6 and 7.

The construction of the barn is shown in detail in Fig. 8 where the arrangement of the single stalls is given. The arrangement for double stalls is similar to that shown except that the concrete partitions in the figure should be omitted when the distance from center to center of partitions becomes 10 ft. of each stall. The bottom end is imbedded in the concrete while the top is inserted in a hole bored by a special drill which left a core of top rock in place around which the pipe fits tight. All other construction is of concrete except the water troughs, which were originally intended to be of concrete, as shown by Fig. 8, but were changed to the cast-iron standard trough of the company shown in Fig. 3. The partitions forming the stalls, and the

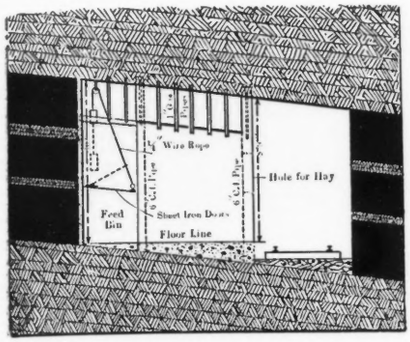


FIG. 6. END ELEVATION OF FEED ROOM SHOWING ARRANGEMENT TO OPEN AND CLOSE THE SHEET-IRON DOORS OVER THE FEED BINS

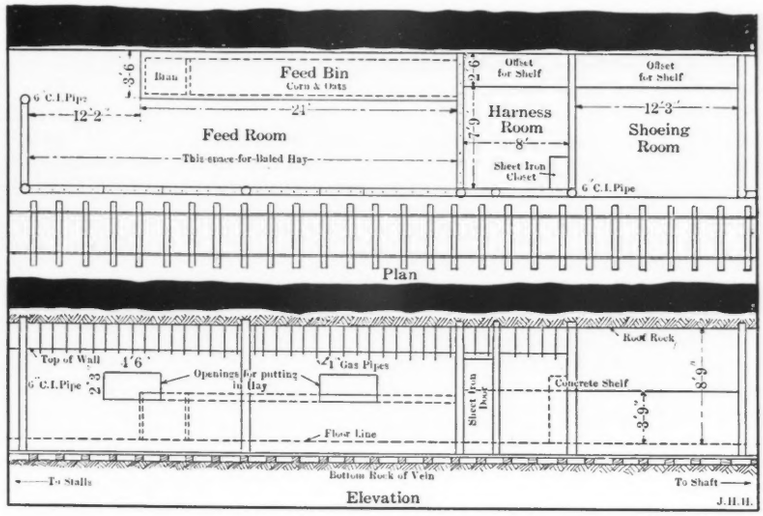


FIG. 7. PLAN AND ELEVATION OF SHOEING, FEED AND HARNESS ROOMS

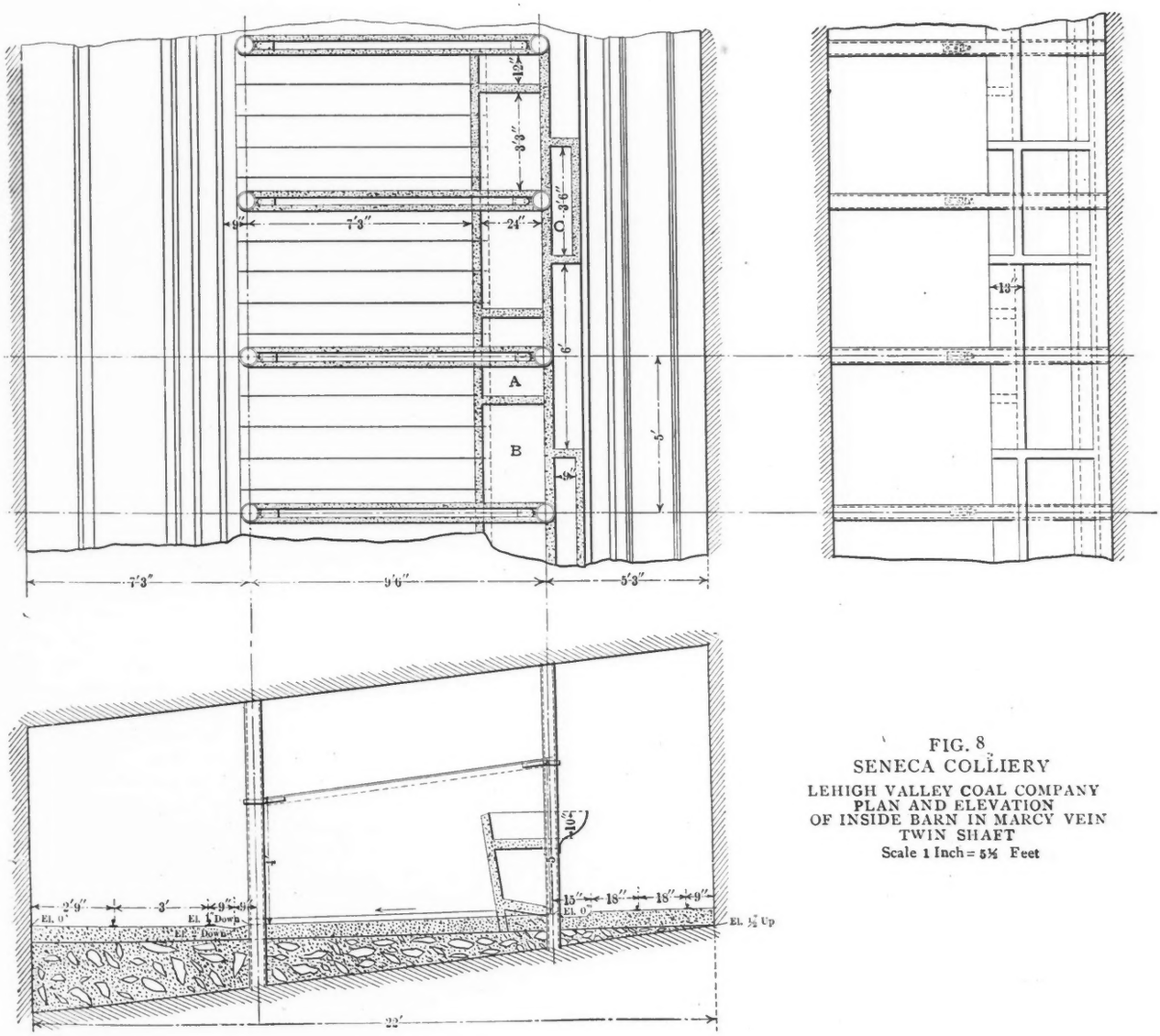


FIG. 8
SENECA COLLIERY
LEHIGH VALLEY COAL COMPANY
PLAN AND ELEVATION
OF INSIDE BARN IN MARCY VEIN
TWIN SHAFT
Scale 1 Inch = 5½ Feet

mangers, are of concrete throughout. During the construction of the feed box, "A" Fig. 8, the corners instead of being square as shown were well rounded to prevent the feed from lodging in the corners.

The track for conveying feed has not yet been installed. The rails of the manure track are laid directly on the concrete, being held in place by the regular size spike driven into a wooden plug inserted in the concrete; in this way, ties are dispensed with, making considerably less wood in the barn than would otherwise be the case. The track is laid in this way from the end of the feed room and extends the whole length of the barn.

Water and Light

Fresh water is conveyed from the surface by a pipe led down a 2-in. bore hole, the pipe connecting with the mains of the Spring Brook Water Company, and the consumption being determined by meter. From the bore hole inside, the water is conducted through an inch pipe laid along the front of the stalls. From this line a branch pipe comes up at every other partition as shown in Fig. 5, and supplies two troughs. To the end of this branch pipe, a hose can be attached for washing the stalls and the concrete.

The barn is electric lighted as are also the feed and other rooms. A light is placed about centrally over each stall, the lights being regulated by a switch in the harness room. In addition to this the partitions and the ribs of the chamber have been given a good coat of whitewash so that the light is all that is desired.

Heidelberg Colliery Barn

At the Heidelberg colliery the construction of the barn is almost identical with that of the Seneca, but its requirements did not call for work on as large a scale. The only difference in construction is that 4-in. pipes were used in place of 6-in., and the barn location was not suited for getting a car in to handle manure. This, however, was not necessary because the barn is of short length and the manure can be barrowed to a door which opens in the concrete wall at the end of the barn; the refuse is here dumped into a car the top of which is level with the floor.

The barn was constructed on the site of the former wooden barn located a short distance from the number two shaft in the Red Ash seam, which is of less thickness, but heavier pitch, than the Marcy seam at Seneca. This barn accommodating 32 mules, is without the feed room as at Seneca, but contains the similarly constructed feed bin of smaller dimensions. Here too are lacking the electric lights; several big Dietz lamps, suspended from hooks in the roof furnishing the light. The harness in use, as in the Seneca barn, is hung directly back of each stall on hooks in the roof, as shown in Fig. 2. Drainage of both barns is effected through front and rear gutters which conduct the contents to the lowest point where it enters a pipe laid under the concrete floor and which leads to the sump (see Fig. 4).

It is hardly necessary to point out the many important features of the barns, except to say that their construction makes them unquestionably sanitary and fireproof, and their maintenance economical. In connection with the latter, the water bill for one month at the Seneca stable amounted to only $1.30, or approximately 2c. per mule. This includes, of course, the water used periodically for cleaning. While there are no figures available in connection with the use of one or more large troughs in the former barns, because water was let run and wasted and the quantity was not determined by meter, it certainly was far in excess of the figure just stated. Then, too, as was said before, the concrete feed bins are already showing a big saving in feed, just how much is not yet determined since the stables have not been long in use.

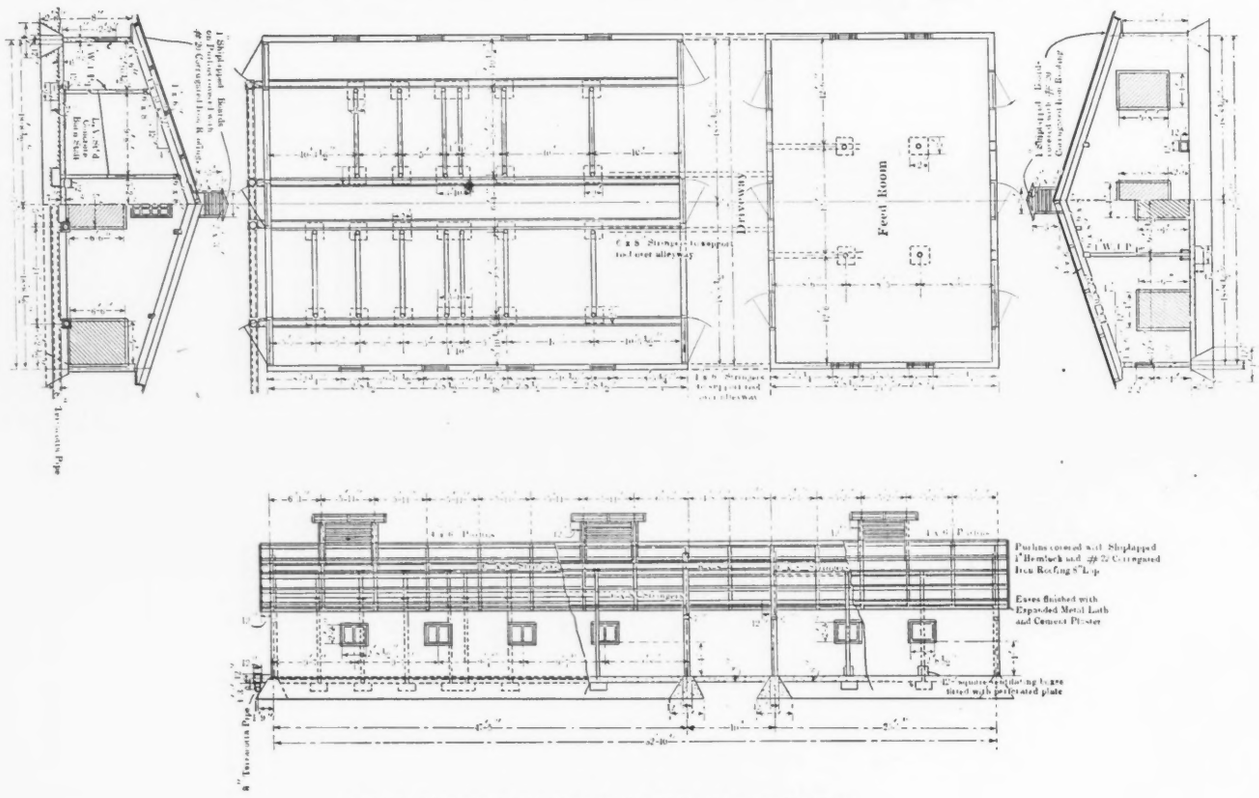


FIG. 9. CONCRETE OUTSIDE MULE BARN AND FEED ROOM

Outside Barn

Interesting in connection with the use of concrete for the construction of underground barns is the use of the same material for outside stables. These are always a source of danger from fire, especially where they are located in close proximity to railroads. The barn shown in Fig. 9 and in the illustration Fig. 10 has just been completed at the Seneca colliery, and concrete construction was followed because the most suitable location for the barn unfortunately was between the Lehigh Valley and the Delaware, Lackawanna & Western railroads, over which much traffic is accomplished, and the destruction of a wooden barn was a

foregone conclusion. The stable contains a large room for hay with wide doors through which baled hay is unloaded from railroad cars placed on the supply track for that purpose. The barn also contains a hospital compartment for sick and injured mules. The stalls and mangers are of the construction as used for the inside barns. Reference to the drawing Fig. 9 will show the construction without further description.

Costs

The following figures show the actual amounts expended for each of the stables:

	Labor.	Material.	Total.
Seneca (Inside).....	$2543.39	$748.46	$3291.85
Seneca (Outside).....	916.91	857.14	1774.05
Heidelberg (Inside)..	973.72	285.50	1259.22

Taking then the two inside barns we have for the Seneca colliery barn which accommodates 64 mules, and the Heidelberg for 32 mules, the following:

CONSTRUCTION COST PER MULE.

	Labor.	Material.	Total.
Seneca.....	$39.74	$11.69	$51.43
Heidelberg.....	30.43	8.92	39.35

There still remains some little piping to be done at Heidelberg barn, but this will not materially change the figures given. The differences in costs are accounted for in several ways. For instance, in the first place, the location for the Seneca barn was not similar to Heidelberg. The chamber at Seneca had to be cleaned of gob from the entrance to the end of the barn, which includes also the space occupied by the hospital car, shoeing, harness and feed rooms. This necessarily made the labor much higher than at Heidelberg where little work had to be done aside from tearing the old barn out. The stall partitions in the Seneca barn being thicker, in addition to the well constructed and finished feed room, etc., obviously made the unit cost for material higher. There is also the manure track in the Seneca barn, and the electric wiring for lights, the labor and material for which are lacking in the Heidelberg barn.

We therefore have two cases upon which we can estimate. The Seneca barn furnishes us a unit cost for labor and material where the barn will be at a new location and in an abandoned gobbed-up chamber. The Heidelberg barn furnishes a like figure where an old wooden barn is to be torn out and replaced with one of concrete. We have for the former case, then, approximately, labor, $40; material, $12; total, $52. For the second case, labor, $30.50; material, $9; total, $39.50 per mule capacity.

The proportions used for the concrete of the two underground barns were 1:2:5 and 1:3:6, the first proportion having been used for the thin partitions, such as divisions in the mangers, feed bins, etc., and the second one for the base and for the heavy partitions such as the stalls, walls, etc. The broken stone used for the work was the chestnut-size slate from the breaker. This was equivalent to stone over a ¾-in. square mesh, and was, of course, most uniform in size.

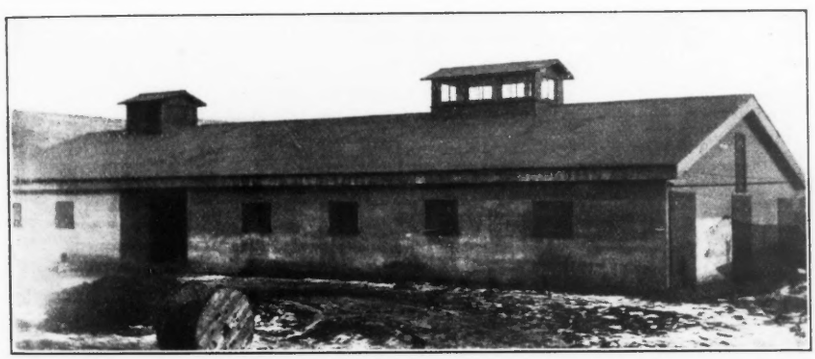


FIG. 10. OUTSIDE CONCRETE MULE BARN, SENECA COLLIERY, LEHIGH VALLEY COAL COMPANY

World's Coal Supply

In a report recently issued by the British Board of Trade, it is estimated that the world's coal production in 1906 was about 905 million tons, to which the United Kingdom contributed rather less than a third. Nine-tenths of the total was raised by five countries, and their output for that year, and also for 1904 and 1905, is given below:

	1904. Tons.	1905. Tons.	1906. Tons.
United States....	314,122,000	350,821,000	369,672,000
United Kingdom	232,428,000	236,129,000	251,068,000
Germany	118,874,000	119,350,000	134,914,000
France.....	32,964,000	34,652,000	33,762,000
Belgium	22,395,000	21,506,000	23,232,000

In the United Kingdom, the United States, and Germany the production in 1906 was greater than in any previous year. In France the falling off of nearly 1,000,000 tons may be accounted for by the strike in the northern coal fields early in the year. The production of the United States now exceeds that of the United Kingdom by nearly 50 per cent., while, on the other hand, the production of Germany represents only about a half, and that of France and Belgium together rather more than a quarter of the production of the United Kingdom.

As compared with its population, the production of coal in the United Kingdom still surpasses that in the United States. It amounts to 5¾ tons per head, while in the United States it is rather more than 4⅓ tons. In Belgium the figure is 3¼ tons per head, in Germany about 2¼ tons, and in France under 1 ton.

Among the outlying portions of the British Empire, India has the greatest output, with 9,783,000 tons. Canada follows with 8,717,000 tons, and Australia with 8,596,000 tons. Next comes the Transvaal with 2,583,000 tons.

The number of persons employed in 1906, above and below ground, in each of the principal producing countries was: United Kingdom, 837,100; United States, 626,300; Germany, 493,300; France, 171,500; and Belgium, 134,700. As regards the output per person employed, the United States takes the first place with 560 tons, the United Kingdom second place with 282 tons, followed by Germany, France, and Belgium, with 242 tons, 202 tons, and 159 tons, respectively.

The United States is far and away the greatest consumer of coal, as well as producer, and her total consumption was last year more than twice that of the United Kingdom. In the following table the consumption in tons is given for the leading countries, both as a total and per head of the population.

	Total. Tons.	Per Head. Tons.
United States.....	361,492,000	4.30
United Kingdom.....	174,329,000	3.99
Germany.....	119,282,000	1.94
France.....	50,298,000	1.28

Railway locomotives in the United Kingdom used 12,093,000 tons in the year, as compared with 11,593,000 tons in 1905, and 11,445,000 tons in 1904.

France was the best customer for British coal in 1906, taking 8,381,000 tons, and Germany, in spite of her own large exports, took 7,512,000 tons from us. France imported altogether 18,289,000 tons, and Germany 10,175,000 tons. Thirty-five tons were brought to the United Kingdom from abroad; the reason is unexplained.

Cost of Mining

The cost of production of anthracite coal not only varies in every mine, but in different seams in the same property, and even in different districts of the same bed. It largely depends on local conditions and the thickness of the seam. In mining a bed which varies from 6 to 8 ft. in thickness, and where no roof is to be taken down or bottom lifted, rock work is avoided and the miner gets no yardage, consequently the operator has "cheap coal." In seams 3 ft. thick, from 3 to 4 ft. of rock work must be done and yardage paid to the miner. For mining such beds, in Lackawanna county, Penn., it costs the operator $1.95 per ton, to say nothing of the cost of transportation, hoisting and preparation for market.

An experienced breaker boss says that 50 per cent. better separation is obtained from the use of spiral slate pickers, now largely used in the preparation of anthracite coal, when the material treated is dry, than with wet material. This may be due to the surface tension of water on the picker and on the coal.

Mine Surveying and Office Methods

The Exercise of Much Care Is Necessary When Carrying a Meridian Underground with Only One Shaft Available

BY CHARLES ENZIAN*

The subject of mine surveying as understood at present, if considered in detail, would consume more space than can here be devoted to it, and must therefore be treated in abstract. It is also my intention to discuss briefly some of the elementary principles which as a general rule are not treated in handbooks on the subject of surveying.

The Mine-surveying Corps

A mine-surveying corps is generally composed of five men: backsight, foresight, second-noteman, first-noteman and transitman, the latter being in charge of the party. The duties of each member of the corps vary with the system employed. Two general methods of putting survey stations in a mine have been successfully used; the first is the "drill-hole" station, and second, the "spad" station.

It is understood that stations in the mines are most permanent when established in the roof of the seam. The drill-hole station is made by means of a small "T"-shaped drill with a ⅛ in. bit; the latter may be mounted at the bottom end of the single rod (Fig. 2). The spad station consists of a spad (either steel, copper or bronze) driven into a white-pine plug wedged into a ⅜-in. drill hole, from ½- to ¾-in. deep. The advantages of the drill-hole station over the spad station have been substantially proved.

Each man on the surveying corps is equipped with the regulation miners' cap and lamp. The backsight carries a single rod, transit plumb-bob, an extra supply of bob cord and a two-quart can of oil. His duties are to help the second-noteman orient or "set up" the transit over the "spot" established by suspending the bob from the station. This is the temporary or trial set-up. The backsight then inserts his rod into the station hole suspending the bob over the transit-head point on the telescope, while the transitman by means of the shifting plate permanently orients the transit.

The foresight carries a single rod with a cast-iron bob, paint can and brush. He selects the most advantageous position for each station, both as to extension and good roof, sounding the top rock with his rod or T-drill. It is also the foresight's duty to help the second-noteman measure roof distance and record seam sections, besides giving sight to hight of instrument for vertical angle, and painting the station number on the roof near the station.

The second-noteman is provided with an 8- or 10-ft. measuring pole which he uses to estimate the offsets at all ribs and intermediate points from a tape stretched between the two stations. Offsets are taken at 20-ft. intervals and are called out to the first-noteman who records the figures. Vein-section measurements are noted by the second-noteman and verified by the first-noteman, as is also the dip, direction and strike of the seam.

The first-noteman acts as assistant transitman and records such notes other than transit observations as will enable reproducing a sketch of actual mining operations upon company maps kept for the purpose. A special volume is kept for transit readings, while "offset" notes are recorded in a separate book. Fig. 3 represents a page of notes as recorded by the first-noteman. The date, seam and organization is noted at the foot of the page and all observations recorded reading from bottom to top.

The figures along the left margin [(*a*) Fig. 3], indicate the plusses on the tape with O at station 450. Figures to the right and left of the dotted line (transit line) indicate offsets to ribs. The measured distance between stations 450 to 462 is also recorded. At the face, station 462 + 10, a dip of 10 deg. "in and to the left" is indicated; it is also noted that section 60 (S-60) was taken on the right rib at face. Along the inside rib of the inside crosscut the measurement of pillar is 24 ft. In the back of the side-note book are recorded the sections, writing forward, fully referenced. As for example, S-60, page —, station 462 + 10. A section of seam is recorded as follows:

HARD SANDSTONE ROOF.

		Coal.	Slate or Bone.
= Benches have no parting	0.4 < Boney coal		0'.4
	2.7 = Coal	2'.3	
= Benches have parting	3.1 = Slate		0.4
	4.1 < Coal	1.0	
	4.9 = Boney coal (streaked)		0.8
	7.9 < Coal	3.0	
		6.3	1.6
Total.....	7.9		

The notes in (*b*), Fig. 3, indicate a roll or fault from station 455 + 53 to + 88 along left rib. Also a roll in the face dipping 16 deg. and in a diagonal direction from right to left, and indicated as a down-throw.

While the backsight and second-noteman are setting up the instrument, the transitman looks up his references and backsight course, and records at least some of the notes for the section connected with the previous survey. The transit, after set-up is satisfactory, is sighted to the backsight station, and then the new station is observed and readings recorded as shown in Table I.

TABLE I. TRANSIT READINGS

Stations.	Horizontal Angle—Azimuth.	Calculated Course.	Vertical Angle.	Measured Distance.	Difference in Elevation.	Horizontal Distance.	Roof Distance.	Remarks.
		Feb. 1, 1908—Brown, Perry, Sm	Baltimore ith, Jones,	Vein—Doe an	No. 2 Level—East. d Evan	Evans	Fireboss.	
318—450	318° 21'						450 = 6.05 L.T.	
318			+1'.54					
450—462	336° 55'	S.23° 05' E.	+5° 15'	83.90	+6.14	83.55	462 = 6.20 B.	In gang.
400—455	336° 29'						455 = 6.35 L.R.	
400								
455—463	333° 01'	S.26° 59' E.	+4° 30'	84.51	+6.63	84.25	463 = 6.25 L.R.	In average.
300—401	95° 00'						401 = 6.11 L.T.	
300			—1'.0					
401—464	335° 30'	S.24° 30' E.	+2° 23'	137.89	+6.73	137.77	464 = 6.05 L.T.	In chamber.

As will be noted from above form of notes, the horizontal angle is measured in azimuth, with 0 deg. as south, 90 deg. = west, 180 deg. = north and 270 deg. = east.

Station 450 is the set-up station, and 318 the backsight station. The roof distance, in order to obtain new datum, as will be explained under office methods, is measured and recorded. In the third column the magnetic bearing of the line connecting the two stations is recorded; this is worked out during spare moments in the mine and is obtained by deducting 336 deg. 55 min. from 366 deg. = *s*. Readings betwen 0 and 90 deg. are direct

*Division engineer, Lehigh Valley Coal Company, Wilkes-Barre, Penn.

courses; between 90 deg. and 180 deg. are deducted from 180 deg.; between 180 and 270 deg. deduct 180, and between 270 deg. and 360 deg. are deducted from 360 deg. The differences are the magnetic courses for corresponding quadrants.

In the fourth column for stations 450-462 will be noted $\frac{+ 1.54 \text{ ft.}}{+ 5 \text{ deg. } 15 \text{ min.}}$ This indicates that the vertical angle + 5 deg. 15 min. was read at 1.54 ft. above H. I. (hight of instrument), and the corrections are applied in the office work for calculating the correct "difference in elevation." This is obtained in the following manner: The cosine of 5 deg. 15 min. is found to be 83.90 = horizontal distance 83.55 ft., and the sine for same angle = 7.68 ft., but as the angle was measured 1.54 ft. above H. I. the true distance in elevation = + 7.68 − 1.54 = 6.14 ft. Similarly a correction of 1 ft. is necessary for difference in elevation for stations 401-464, where the angle was measured 1 ft. below H. I. The sine for the distance and angle = 5.73 ft., therefore the true difference in elevation = 5.73 + 1.0 = 6.73 ft. The algebraic sign for these corrections represents the field operation and is the reverse of the algebraic correction.

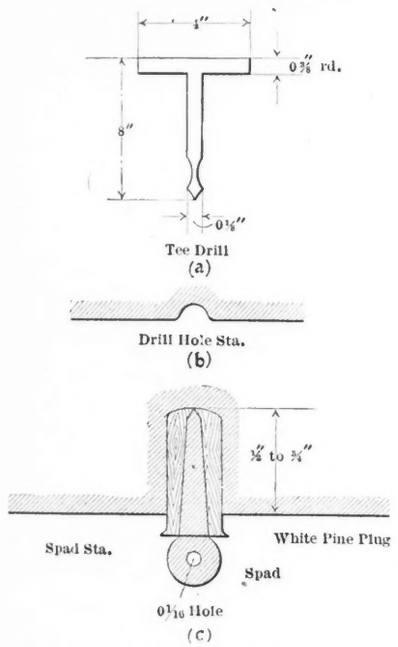


FIG. 1. SPAD AND DRILL HOLE STATIONS

Setting Chamber Centers

While to mine surveying are also assigned the duties of preparing ventilation and transportation charts, the object of this article is to treat only that part of the subject involving instrument work. In addition to surveys of mine workings at stated or regular intervals, the engineering department is required to set lines for chambers, and in many cases in horizontal seams, for gangway workings. This work is done by a party of two, generally an assistant transitman and a chainman, backsight or foresight. The form of notes, less complete than survey notes, are similar. A regular transit note book is used and readings are recorded as follows:

Stations and Spads.	Azimuth.	Needle or Magnetic Reading.	Vertical Angle.	Distance.	Remarks.
318—450	318° 21′				
318					
450—Spad$_1$.	247° 00′	N. 67° 00′ E.	....	50.0	
Spad$_1$—Spad$_2$.	338° 00′	S. 22° 00′ E.	....	10.6	Chamber 11 Road 306.

The lines are established by setting two spad stations as described in Fig. 1 (*c*). A stout twine is placed in the spad hole and weighted so that the miner can line up and mark the face. Whenever an extension is necessary it is usually done by eye, and no farther instrument work for that particular working place will be necessary until the regular survey is made, unless a spad drops out.

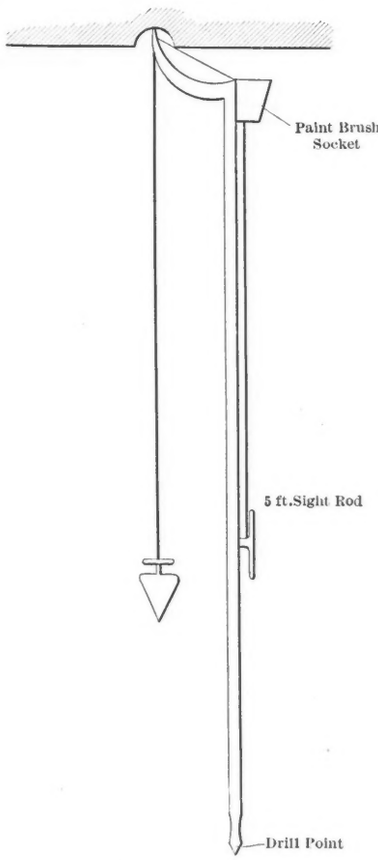
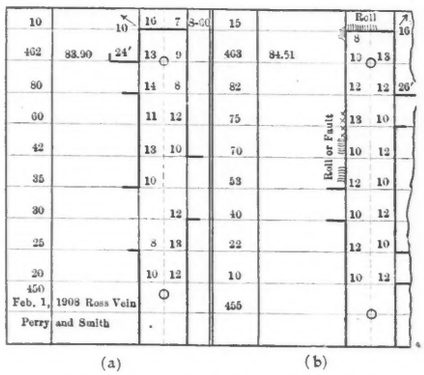


FIG. 2. SIGHT ROD USED BY LEHIGH VALLEY COAL COMPANY

Plumbing a Shaft

In slope or drift workings the meridian and coördinate system is established in underground workings by very carefully tied surveys; but for shaft workings a more tedious and skilful operation is necessary. In either a slope or shaft transfer, the starting points should be from stations in a primary triangulation system. In Fig. 8 (a) is shown the most desirable location for outside stations V to VIII in the primary system of triangulation.

Assume that the transit is set up at station VI, with backsight to either VII or V, a check sight is taken to VIII; if this sight does not agree with the triangulation course between the two stations the transit should be re-set to get the proper orientation. When all sights check (VI to V, VII and VIII) a station is placed at the mouth of the slope and numbered 1; the regular operation of measuring with standard pull and temperature is then accomplished and noted. The survey is then continued to the foot of the slope, recording the temperature at each measurement. At the bottom of the slope a triangular loop is surveyed, and the survey is repeated up the slope using the same stations as descending, but giving them new numbers carefully refereneed to the old numbers. It should be a rule of the transitman not to compare notes of any previous survey until the final sights are again read.



.. FIG. 3. SPECIMEN OF SIDE NOTES

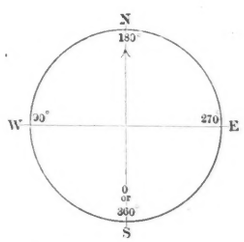


FIG. 4. HORIZONTAL ANGLE IS MEASURED WITH 0 DEG. AS SOUTH

The method of using the old stations in the check survey, will enable the sight, on which an error may be detected, to be investigated in case the survey does not tie after temperature corrections for measurements have been made. Fig. 8 (b) shows

the arrangement for 3-wire plumbing. If the shaft is not deep, say less than 500 ft., two wires will be sufficient until a check plumbing by means of a second opening can be made. For depths over 500 ft., in all cases, 3 wires should be employed.

With the transit at station II or III, the sighting in all cases to IV, are taken to spad *C*. This is done with the crosshead of the hoisting carriage about 2 ft. below the landing level. Careful measurements are taken, repeated three times, to wires from stations II and III, also from V and VI. The party then goes to the foot of then lowers the wires to the bottom of the shaft, where 10-lb. cylindrical bobs are attached and placed in the tanks of oil. After all slack is taken out of the wires, they are carefully centered into crotch *K*. Brown & Sharpe No. 22 steel wire gives satisfactory results.

ENGINEERING DEPARTMENT

Station	Horizontal Angle	Verticle Angle	Distance	Course	Horizontal Distance	Northing	Southing	Total Northing	Total Southing	Easting	Westing	Total Easting	Total Westing	Roof Distance	Verticle Height	Elevation
450	326° 55′	+ 1° 54′ + 5° 10′	83.99	S 23° 05′ E	83.55		76.86	9809.61		32.76			1853.95	L.T. 6.05	+ 6.14	662.58
462	–							9812.75					1821.19	B. 6.20		668.72
455	313° 01′	+ 4° 50′	84.51	S 20° 59′ E	84.25		68.31	9922.02		38.23			1870.69	L.R. 6.35	+ 6.03	656.04
453								9353.68					1890.43	L.R. 6.25		663.57

FIG. 5. GENERAL STYLE OF TRAVERSE SHEET EMPLOYED BY SOME ANTHRACITE COAL COMPANIES

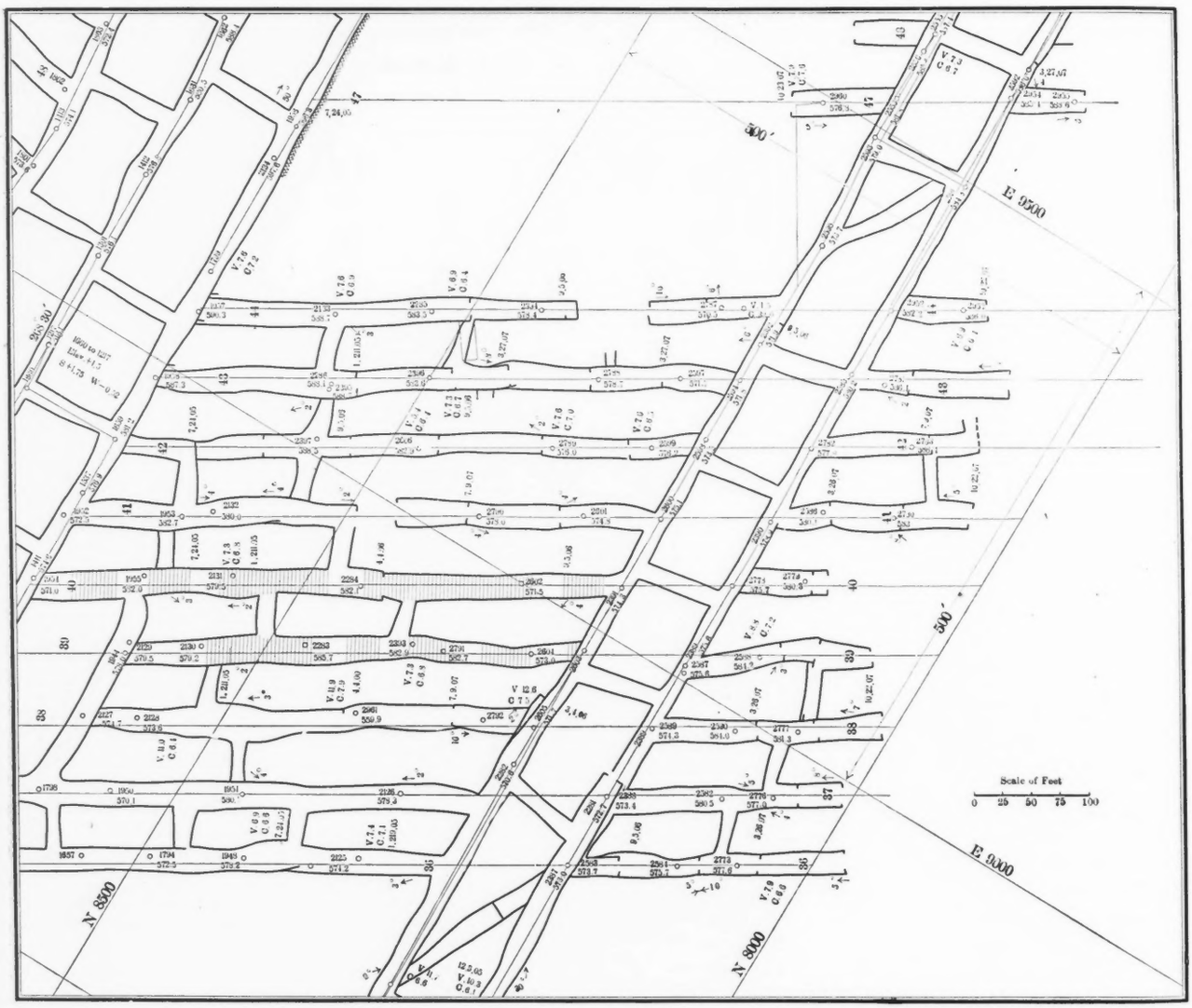


FIG. 6. PORTION OF A MINE MAP SHOWING COORDINATE LINES AND SURVEY STATIONS

wires *A* and *B* are placed on line, i.e., spads of the shape shown in Fig. 8 (c) are placed in the timbers, with intersecting V's, shown at *K*, on line between the two stations, carefully centered by passing the plump-bob string through crotch *K*. Similarly sights from II and III, back-

the shaft, leaving one man in charge of the wires at the surface.

The party (transitman, assistant transitman and foresightman) then place a 10-gal. iron tank filled with black oil on the cage where the wires from the surface will suspend. The man on the surface

As soon as the bobs are placed in the oil tanks, being careful that they have sufficient clearance of bottom, the party can establish stations in the floor approximately for 1, 2, 5 and 6; from these preliminary stations, 3, 8, 9, 4 and 7 can be established permanently, and angles and

distances measured while the wires are steadying. When the wires are almost steady, papier-mâché washers, through which the wires have previously been passed, are released and allowed to drop to the bottom. This is to make certain that the wires are hanging freely. The transit is then set up at station I on line of the wires *A* and *B* produced, the plates are set approximately on some known course. The operation is repeated for points 2, 5 and 6, and a system of tied triangles is established.

The single-shaft plumbing should be verified as soon as the second shaft is opened. This is done by a single wire in each shaft, and tied surveys to these wires both on the surface and underground. Relative coördinate values are thus obtained for each wire, so that a check can be made by calculating and comparing the surface and underground courses between the wires. The inside meridian is then corrected to outside values. If more than two shafts are available, the results will be more accurate as it then forms an underground system of triangulation. For work of this character, the temperature correction for all measurements should be made to correspond to about the average temperature of the mine, say 56 to 65 deg. Fahrenheit.

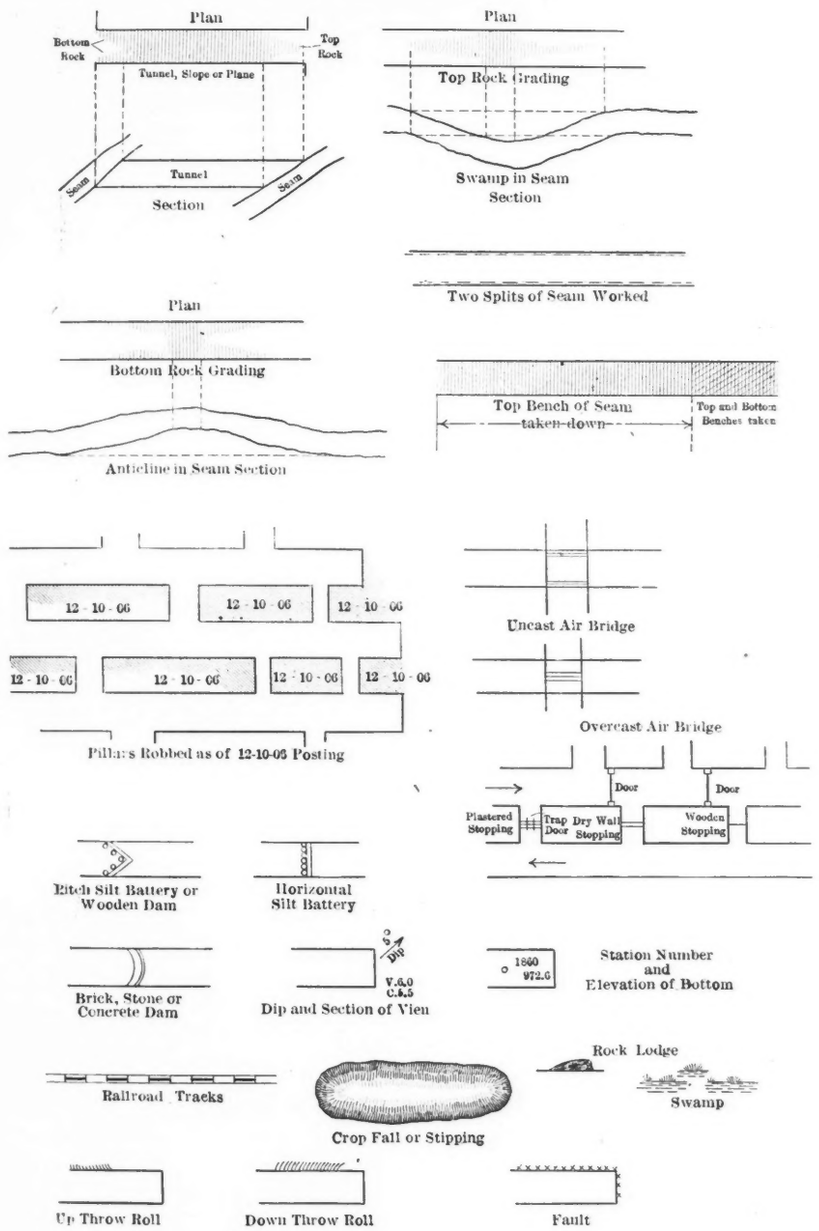


FIG. 7. CONVENTIONAL SIGNS USED IN MAPPING

Office Methods

The work in the office, calculations, checking, plotting, tracing and filing, consumes about 80 per cent. of the time of the field work, and in order that all members of the corps get the best possible experience, should be performed by those who do the field work. One or two extra men for general office work such as borehole record plottings, transportation and preparation charts, special drawings, etc., will be sufficient in most cases.

After the field work is finished, the calculations for horizontal distances and differences in elevation of stations are completed by the use of Gurden's Traverse Tables of natural functions for each minute of arc, from 1 ft. to 100 ft.; the results are entered in the transit book as shown in Table I. These are also copied into a traverse book, the form of which is shown in Fig. 5.

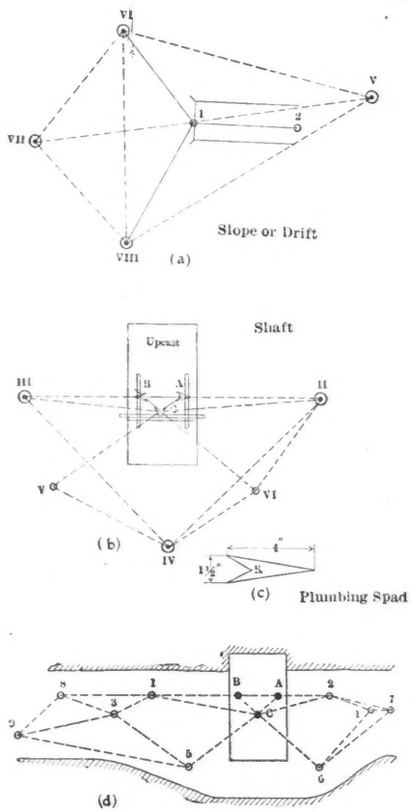


FIG. 8. LOCATION OF SURVEY AND TRIANGULATION STATIONS IN SHAFT PLUMBING

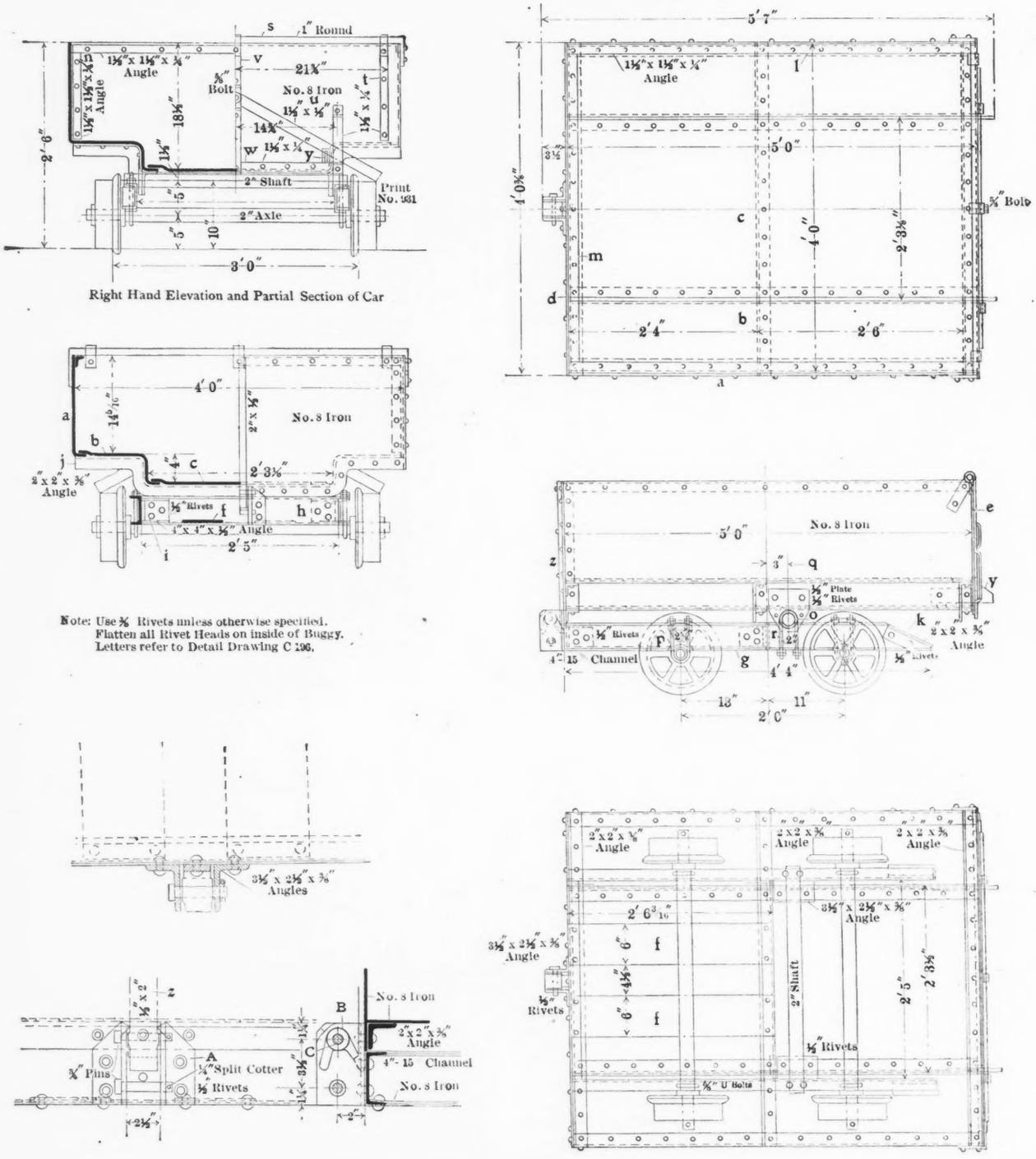
The transit by means of the shifting head is centered on line, and a point is firmly fixed in the floor, either by a tack in the tie or in a plank firmly spiked or weighted down. Before unclamping the transit plates, they should be carefully read and checked; then a sight is taken by plunging the telescope to stations 3 and 8. A direct reading is then recorded, after again sighting on the wires, and to 2, 3 and 8.

The calculations are assigned to the backsight and foresightmen, while second-notemen and first-notemen calculate the bearings or magnetic courses. The transitman supervises the work and copies the transit notes into the traverse book, and enters the calculations as completed.

Calculating Mine Elevations

Changes in tracks, grading, etc., will oc-

casionally affect roof distances, and as all elevations are referenced to the bottom, new roof distances are measured at all set-up stations so as to properly plane the transit; this must be done in reference to was later used for extending the survey, the track may have been lowered or raised, and in order to have the extension survey on the same datum as the old survey, it is necessary to determine the *H.* I. by refer- taken in the field in case the transit book is lost. When calculations are completed, the first-noteman plots the gangway stations by the coördinate system and the chamber stations (which are not traversed) by



Right Hand Elevation and Partial Section of Car

Note: Use ⅜ Rivets unless otherwise specified.
Flatten all Rivet Heads on inside of Buggy.
Letters refer to Detail Drawing C 196.

STEEL MINE BUGGY DESIGNED FOR THIN COAL SEAMS

the roof, as it is permanent so long as the station still exists while the bottom may have changed.

When station 450 for example, was established, the roof distance was determined and the total elevation of the roof at this point was calculated. When this elevation encing to the bottom. In this way the new elevation is equal to the old elevation plus the old roof distance minus the new roof distance.

The form of traverse book shown in Fig. 5 is considered most complete as it furnishes an exact duplicate of the notes protractor. The transitman checks this work by protractor.

The offsets (sidenotes), are then plotted and inked on the map, after which the office tracings are posted; subsequently the foreman's tracings and ventilation tracings are brought up to date.

When a new map is necessary, the paper is cut from a large roll and laid out on a drawing table to season. Generally a week or two elapses before the coördinate system is blocked out. Where a system of tinting the property boundaries, to show whether the coal is leased or in fee, is adopted, the border of the map and the tinting is done before the land lines or the coördinate system are inked. Whenever possible the coördinate lines are so blocked as to bring some important land line parallel with the border. The gangways and chambers are numbered, as for example 48-2 signifies road No. 48 chamber 2; 48 A-2 signifies airway to gangway No. 48 and No. 2 chamber off same. Fig. 6 shows the completed work.

A New Style Steel Mine Buggy

By Douglas Bunting*

The increasing demand for suitable mine cars during recent years, in the anthracite mines, has been due to the working of thinner veins in collieries already equipped with cars not adapted to these changed conditions. The buggies generally in service are poorly designed and are not well suited to the service in which they are now being used.

The design shown in the opposite illustration is intended to produce a buggy better adapted to the present demands and conditions. It has a water-level capacity of approximately 27 cu.ft., and is of the dumping type, which feature will permit of a considerable saving in rock work otherwise necessary for the accommodation of the present mine cars and the dump chutes necessary when a rigid buggy is used.

Design and Operation

Steel and iron are used exclusively in the construction of this buggy; the axles and dumping shaft are rigidly connected to the channel frame, the dumping shaft passes through stiffened plates riveted to the body of the car. The buggy is dumped by releasing the pawl located between the draw-head angles, the angle of inclination when dumped being 27 deg. from the horizontal. The door is opened automatically by the latch bars striking the rails when dumping, or by engaging trippers when not used as a dumping buggy.

The haulage rope is attached to the buggy by means of a clevis and pin through the draw head, or by passing the rope through the hole in the end channel between the draw-head angles and securing same with an ordinary rope clamp; this latter method is used when buggies are operated in pairs on a gravity hoist, and the coil of excess rope necessary for the extension of the working face, is placed on the plates riveted to the lower flanges of the channels and supported on the front axle.

*Chief engineer, Lehigh and Wilkes-Barre Coal Company, Wilkes-Barre, Penn.

Fatalities in Mines

The past record of fatal accidents in anthracite mines, shows that the number of days worked in a year has a great influence upon the number of fatalities in the mines. It is a fact that in the years the men worked the least number of days, there occurred the highest number of accidents per one thousand employed. Collieries worked 200 days or over averaged from 1.4 to 1.8 fatalities per 1000 employed, while those worked 175 days or less averaged from 1.8 to 2.5 fatalities per 1000 employed.

There are reasons for this: The mines that have been worked regularly are much safer than those that have been operated intermittently. When the mines are worked every day, all the working faces can be kept in good condition, but if worked two or three days in a week the places needing immediate propping do not get the same attention as under normal operations, consequently the number of accidents is increased. Moreover, when the miners work every day, they usually follow a system of mining which promotes the maximum of safety without curtailing the output, whereas if they work only two or three days in a week it is quite natural for them to try to produce more coal to make up for the lost time, consequently in their haste they are somewhat less cautious in their methods of working.

Exports of Coal

The exports of coal from the United States in the first eleven months of the year 1907 amounted to 12,145,716 tons as compared with 9,114,671 tons in the corresponding period of 1906. Of this quantity, 2,553,901 tons were anthracite, and 9,591,815 tons bituminous in 1907, as compared with 2,045,801 tons of anthracite and 9,114,671 tons bituminous in the preceding year. Over 9,000,000 tons of the total quantity exported in 1907 went to British North America, 7993 tons to France, 9998 tons to Germany, 133,021 tons to Italy and 59,240 tons to other parts of Europe. The imports of coal in this eleven months' period were 1,890,754 tons in 1907 and 1,556,668 tons in 1906.

Cleaning Producer Gas for Engine Use

The cleaning of producer gas is essential to render it suitable for use in engines. According to James Christie (*Proceedings* of the Engineers' Club, of Philadelphia, July, 1907), scrubbers, in which the gas is cleansed by passing through water, are sufficient when blast-furnace gas or producer gas made from anthracite coal are used. But in producer gas made from bituminous coal there is tar, or soot, or both; these materials cannot be successfully removed by the ordinary scrubber. Tar can be removed, as was done successfully at the producer tests carried on by the Government at St. Louis, Mo., by means of centrifugal action. Another method used considerably in Germany, and to less extent in the United States, is to gasify the tar by means of passing the gas through a secondary bed of incandescent fuel. But the soot or lampblack cannot be removed satisfactorily in this way, and, as it mixes with water very reluctantly, its removal is difficult. Centrifugal washing for removing the soot has been tried with some success. The soot generally does little harm, as it can be allowed to settle in the pipe leading from the producer-gas supply tank and then can be occasionally washed out with water.

Driving Breasts in an Anthracite Mine

In driving breasts in the anthracite field the miners receive a fixed price for a car of coal besides the timbering and rock work, for which they are usually paid at the rate of 5½c. for a thickness of 1 in. and a width of from 6 to 7 ft. per linear yard of breast Out of this, the miner pays for all necessary supplies, which includes powder, tools, oil, etc., besides the wages of his laborer. In many mines, the breasts are started from the gangways full width, which is usually 20 to 28 ft.; much depends, however, on the character of the roof and the thickness of the seam. In flat beds the coal is usually loaded in the cars at the face of the workings. In a thin seam, the width of the breast is such that all the rock lifted from the bottom and taken down from the roof is gobbed on one side of the room. One cubic yard of solid rock occupies one and one-half cubic yards of space, so that the width of the coal face is entirely governed by the amount of refuse to be packed away.

Among the reasons for the failure to build up a briquetting industry in the anthracite region of Pennsylvania, where the best opportunity for its development is offered, has been the opposition shown by some of the operators to the introduction of a manufactured domestic fuel which could compete with the prepared sizes of anthracite. The competition of bituminous coal has almost shut out anthracite as a steam fuel, coke has largely supplanted it for iron making, and coke and gas made from bituminous coal are coming more into use as domestic fuel. On the other hand, the work of mining and preparing anthracite is becoming more expensive, and on the other, competition is becoming keener. Under such conditions the opposition is only natural.

First Aid to the Injured in Coal Mines

The Work Started in 1899 Has Spread and the Results Are Beneficial from a Moral, Social and Humane Standpoint

BY M. J. SHIELDS*

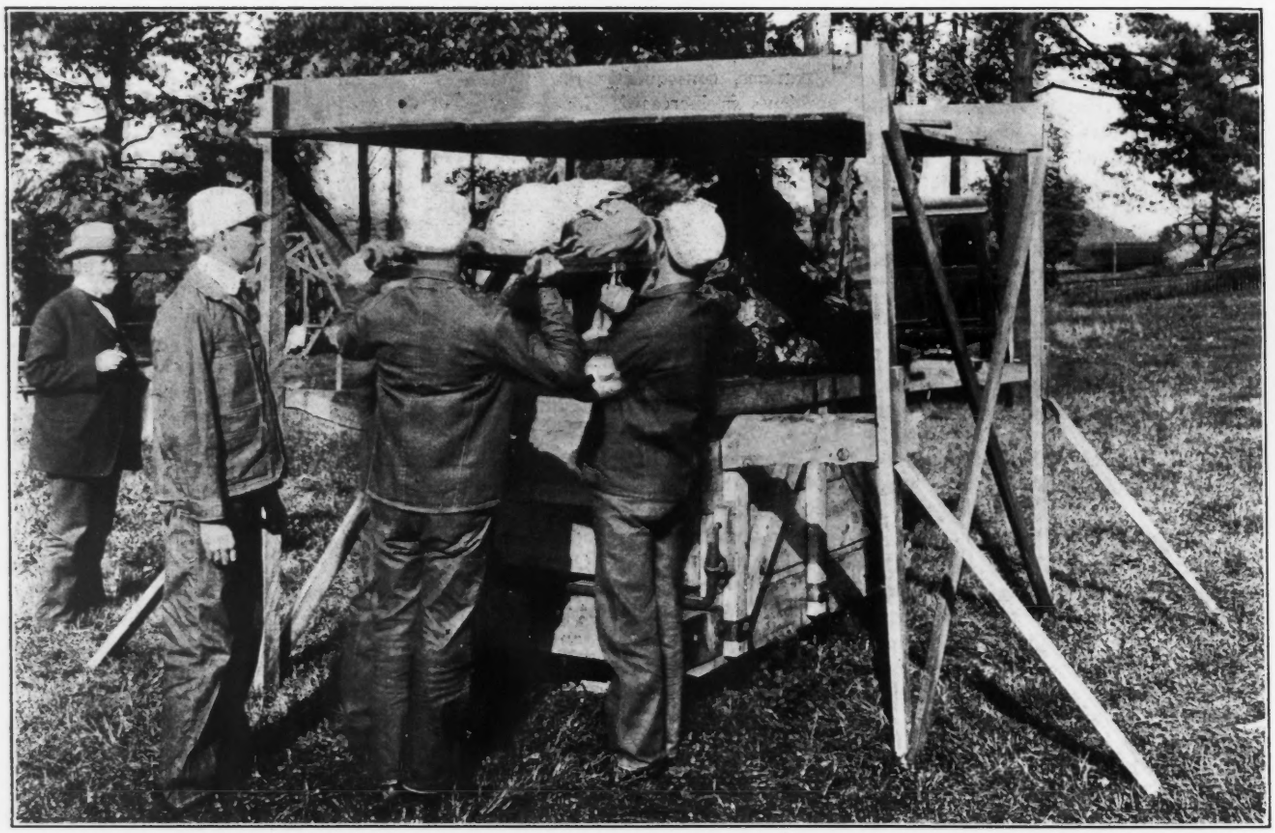
The idea of first aid to the injured had its inception in Europe, about 1880, by the organization in England of the St. Johns' Ambulance Association; the Samariter Verein in Germany, and first-aid corps in France, Belgium and Austria. As an outgrowth of the International Red Cross Society, the St. Johns' Ambulance Association of England is an organization that extends throughout the United Kingdom, having branches or minor associations in every industry, including mines, railroads, iron works, foundries, and amongst all the civil government employees, such as police, firemen and postal employees. It was these men, taken green from the workshop, mine and railway and sent to South Africa in 1900 during the Boer war, who won honor and renown in the hospital corps and had special mention in the surgeon-general's report.

The Samariter Verein of Germany received world-wide praise for their heroic aid in the great mine disaster at Courrieres, France, in 1906, and the corps was photographed and labeled by a leading periodical at the time as "A Peaceful Invasion of France by Germany."

First aid in military operations in the last decade has become as much a necessity as the commisariat, winning its first victory in the Franco-Prussian war in 1870, and adding to its laurels by the marvelous results attained in the Turko-Russian war in 1878, China-Japanese in 1895, Spanish-American in 1898, Boer-British in 1900, and the most brilliant of all, the Russo-Jap of 1905, where not four out of one thousand wounded Japanese had blood poison after being injured, due to the most perfect first-aid ambulance corps that the world has ever seen.

First aid in America did not arrive until 1897, when some of the railroads put a few first-aid supplies on their trains and gave certain of their employees books of instruction. First-aid to the injured societies were also started in several of our larger cities about this time. Canada organized branches of the St. Johns' Ambulance Association. With the assistance of 25 miners employed in the Delaware & Hudson Company's mine at Jermyn, Penn., in 1899, I succeeded in organizing the first aid corps for mine work in America. The men assessed themselves, took up collections and bought first-aid packets, books of instruction, bandages and splints. The company was appealed to, but gave no encouragement. We had monthly meetings, consisting of lectures and drills, and in a short time I had an efficient corps of first-aid men in all parts of that particular mine. Then, the 1900 strike coming on, interest was lost and the corps became extinct.

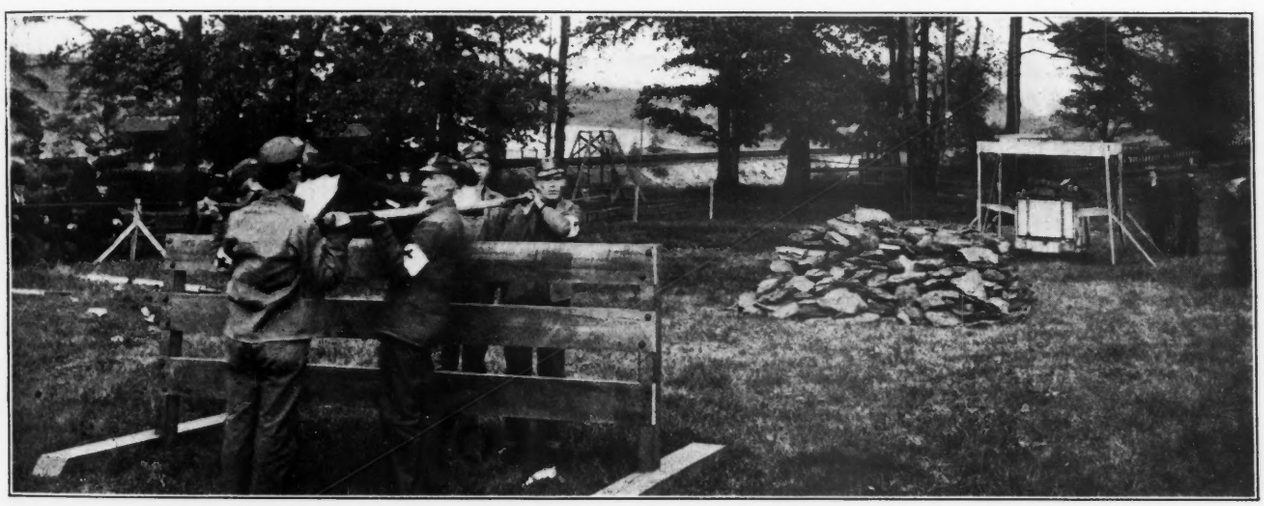
It was not until the summer of 1905 that I succeeded in getting any coal company to take up this movement (although I had persisted in my efforts so strenuously for six years that I came to be



SECOND ANNUAL CONTEST BETWEEN THE FIRST-AID TEAMS OF THE HILLSIDE AND THE PENN. COAL COMPANIES

*Medical director, Pennsylvania Coal Company, Hillside Coal and Iron Company, Temple Iron Company, and Surgeon New York, Ontario & Western Railway, Scranton, Penn.

called a first-aid "crank"), when W. A. May, general manager of the Pennsylvania Coal Company and the Hillside Coal and Iron Company, engaged me to organize a first-aid corps in each of the mines under his management, numbering about 40, and employing, in round numbers, 13,000 men. The following year, 1906, the Temple Iron Company took up this movement, and it has gradually spread until all the coal companies in the anthracite region of Pennsylvania have inaugurated first aid in some form in and about their mines. Without boasting, I feel that I have the honor to have originated this humane work in the coal mines of America, in 1899, and that the Pennsylvania Coal Company, the Hillside Coal and Iron Company and the Temple Iron Company were the first coal companies to inaugurate this life-saving work in a systematic way.



FIRST-AID CORPS CARRYING AN INJURED MAN OVER OBSTACLES AT A RECENT ANNUAL CONTEST

Organization and Maintenance of First-aid Corps

After having had charge, as medical director, of the organization and training of first-aid corps for three large coal companies, I feel that I can in no better way tell how to organize and maintain corps in coal mines than to detail the system, plans, methods of training, etc., by which they are kept up at the various mines of these three companies:

The mining operations of the three companies were first divided into twelve districts, each of these districts having several collieries and a number of openings; a general foreman or superintendent was placed in charge of each district, and this official arranged for a suitable central hall, so as to be convenient for all the men in the district as a meeting place. The hall, of course, is large enough for practice drills and stretcher work. One employee in twenty was selected and invited to attend the meetings, thus making about nine hundred trained first-aid men.

Employees were selected along the following lines: Men who are in and about the mine all day; men so selected as to have a first-aid man in each section of the workings; several outside men, and especially the driver of the ambulance; men not too old or too young; men who stay with the company and not transients; some intelligent foreigners, who can understand and speak English. This to include all classes of employees, namely, inside and outside foremen, fire bosses, driver bosses, engineers, pump runners, breaker employees, and some miners.

Each of these corps met and adopted by-laws, elected its own officers of administration, consisting of president, vice-presidents and secretary, who administer its affairs under the general direction of the company. The foremen and assistants, in and outside, and fire bosses, were requested to have at least three of the men under them present. Meetings are held in each district once a month, excepting the months of July and August. The time of the meetings is from 7:30 to 9:30 p.m. Cards are given each member with the place and date of each meeting during the year, signed by the general foreman of the district. The meetings are called to order by the president, minutes read by the secretary, and then I give a short talk on first aid, illustrated by charts, diagrams, X-ray plates of fractures, and by painting the location of the principal blood vessels and different important organs on the body of the human subject with colored crayons. I also illustrate wounds in the same way.

Course of Instruction

The lecture is short, say thirty minutes, and is as free as possible of medical and technical terms. Following the lecture, a demonstration on a living subject in bandaging, is given, stopping hemorrhages, or applying temporary splints; this lasts about half an hour. After that I have the men themselves practice on a subject, going through such actual operations as performing artificial respiration, carrying the injured, dressing wounds, applying splints to fractures, and a stretcher drill. The meeting is closed with an "experience" session, the men relating actual experiences they have had during the month past in dressing injuries, how they did it, and as far as possible the results obtained, the same being criticized and discussed by all the members present.

Each member of the corps is supplied with a first-aid packet (rubber cover), which he carries constantly in his working coat, and wears a Red Cross button. He is also supplied by the company with a copy of my little First Aid Hand Book, containing simple instructions and illustrations of bandaging wounds and applying dressings to fractures; what to do in emergencies, etc. The book is of pocket size and contains not quite 100 pages. The first-aid men also have access at all times to the well-equipped mine hospital rooms, which are provided by the companies.

This program is varied somewhat at times in order to keep up attendance and interest (the attendance at the meetings being semi-voluntary on the part of the men), by having inter-corps contests, or demonstrations of skill, between teams of five men from different mines; judges are appointed and render decisions in favor of one team or another. The men also arrange for and have smokers, field days, banquets and musical entertainments once a year, which do much toward arousing enthusiasm and keeping up interest, not only among themselves but the general public. In fact, these corps can be maintained on exactly the same plan as volunteer fire companies.

Contests on Field Day

We have once a year a general contest, or field day, which while not absolutely essential to first aid, creates a feeling of friendly rivalry among the different districts. The two general contests of the Pennsylvania Coal Company and the Hillside Coal and Iron Company, held in 1906 and 1907, views of which are shown with this article, have been most successful affairs and were witnessed by large crowds, including nearly all the prominent mine officials of the Lackawanna and Wyoming valleys. The brief details of the one held in Scranton, Nov. 24, 1906, I do not think will make tiresome reading.

The first-aid corps in each district, of which there were eight, were divided up into squads or teams of five; they elected one man captain, and preliminary contests were held in each district; one team was selected by the medical director from the whole corps, and two local physicians, who acted as judges, to represent the district in the final or general contest. This contest was probably the first competitive public exhibition between first-aid corps held in connection with American mining. Each team consisted of a captain, four men, and one subject, upon whom the demonstration was made. The following was the program carried out at the general contest:

Feat No. 1. Man insensible from gas, totally helpless. One man to pick him up, carry him 50 ft. to good air, lay him down and perform artificial respiration for one minute.

Feat No. 2. Man injured in lower part of body. Two men to form four-handed seat and carry him 50 ft.

Feat No. 3. Man injured; leg broken. Three men to splint his leg with a mine sprag and some straw or hay; make temporary stretcher out of two mine drills and two coats, and carry 50 ft.

Feat No. 4. Man injured; wound right side of temple; one man to open packet and dress wound.

Feat No. 5. General contest of eight teams. Man unconscious; wounds, simple fracture of right arm between elbow and shoulder; crushed foot with severe hemorrhage; apply tourniquet for bleeding, splints for fracture, perform artificial respiration for one minute, place on stretcher, carry 50 ft. over car loaded with coal, pile of mine rock, then over fence and place in ambulance.

Regulations for Judges

The following regulations were made for the judges in determining the contest:

1. The captains of the teams are to draw from a hat ballots which are to be numbered from one to eight, and the teams will contest in that order, i.e., the team drawing No. 1 will be the first to contest, and so on.

2. A secretary and two time-keepers shall be selected on the grounds. Also one man to act as announcer.

3. The secretary in keeping his records shall designate the team performing by their number and also the place where they are from.

4. The judges shall be handed slips of paper with the number and name of each team at the beginning of each team contest, so they can keep notes; the judges are also given slips with number, name of team and name of man or men taking part in 1, 2- and 3-men contests.

5. The judges shall arrange a program from the circular which will be announced as a whole before the contest begins, and it will also be announced again plainly and distinctly as each team comes up for trial. The judges shall also mark the injuries in each contest.

6. No practicing on the day of the contest will be allowed.

7. Each team shall have the same trial and shall use the stretcher furnished on the day of the contest.

8. Each team captain shall select men from his team for 1, 2- and 3-men contests. There will be nothing against his selecting himself as one of the contestants.

9. It will be announced that time or speed is not the first or most important consideration.

10. It should also be announced that the several methods of one man carrying another man can be used, but should the patient or subject assist by using his own strength to rise up or help the man carrying him the trial shall be barred. Also, that the difference in stretcher drill shall not militate against the team.

11. The first-aid packet is to be used in open wounds and stopping hemorrhages.

12. The following obstructions will be used: (a) A loaded mine car; (b) an ordinary fence; (c) a pile of mine rock.

Of course, the above program and rules can be varied in many ways to suit the occasion and conditions.

Conditions Essential to Success

The maintenance and effectiveness of first-aid corps depend largely upon the superintendent and mine foremen, for it has been found that in districts where the officials were passive and inactive, the men have been likewise disposed; but where interest obtains, the men follow their leader and take hold zealously by faithful attendance at the meetings, practicing among themselves, and taking interest and pride in the work.

The cost to the companies is not large. The men seeing that it is for their benefit and welfare, donate their services. The halls for practice are secured at low cost. Materials for practice, such as triangles, bandages, wooden splints, etc., cost little, the same material being used over and over again.

And now, in conclusion, aside from the humane features of this work, namely, preventing pain, relieving suffering, forestalling blood poisoning, making quick recoveries after accidents, and sometimes saving life, we must have in mind the effect as to the social and elevating side, encouraging a more friendly feeling between employer and employee, and a closer relationship between foreman and miner. It has a tendency to uplift the men morally, and since no race or creed is recognized, all are united in a glorious and humane work of doing good to their fellowmen.

Jigging Anthracite Coal

In jigging ordinary anthracite coal that has been well screened, the tank should be "slushed' at least twice a day, at noon and at the end of the day's work. With coal that contains considerable dirt, such as that which comes from pitching breasts, in the southern and middle coalfields, it is necessary to "slush" more often, sometimes every two hours. This precaution should not be overlooked, since a large accumulation of dirt under the grate prevents the proper action of the water as well as endangers the grate, which often caves in if the dirt is allowed to accumulate under it.

Capital Investment Per Ton of Output

The amount of capital invested in general equipment in mining anthracite coal, is calculated by one of the operators on the basis of $200 per ton of daily output; that is, if a plant is calculated to produce 1500 tons per day the requisite capital would be $300,000. In cases, however, where lower seams are to be developed, the capital may have to be increased to $500,000 for a capacity of 1500 tons per day. This is particularly true in the Wyoming valley.

In mining seams pitching over 30 deg. a large part of the coal mined is left in the breast, the amount of coal loaded into the cars being such as to give the miner and laborer enough room to carry on mining and build the manway. In this system of working, two miners are often employed and their earnings are equally divided between them. When mining comparatively flat beds, one miner usually drives the breast with the aid of his laborer; the latter gets one-third of the gross earnings of the miner. The average rate at which a miner can drive a breast is one yard per shift for a 24-ft. room in a 4-ft. seam.

The French Government has resolved to confer crosses of the Legion of Honor on the engineers who distinguished themselves in the great Courrières disaster in 1906.