The Engineering and Mining Journal

VOL. LXXXVII. NEW YORK, JANUARY 2, 1909. NO. 1.

Iron Operations in the Chattanooga District

General Conditions Are Similar to Those of Birmingham District; Two of Largest Operating Companies Have Raw Materials close to Furnaces

BY EDWIN HIGGINS

For convenience the Chattanooga district may be said to include the territory 70 miles northeasterly, and 30 miles southwesterly, from Chattanooga, its width varying from 20 to 30 miles. This includes Roane, Rhea and Hamilton, and parts of Morgan, Cumberland, Meigs and James counties, Tennessee; parts of Jackson and De Kalb counties, Alabama, and parts of Dade, Walker and Chattooga counties, Georgia. The southern boundary of the district is not well defined, the iron industry here being more or less intimately connected with that of the northeastern Alabama district.

The Clinton formation, including shales, sandstones and limestones, outcrops at various points north of Chattanooga in the vicinity of the Tennessee valley, and to the south along the northwest slope of Lookout mountain.

As in the Birmingham district, raw materials are found within a radius of a few miles, and conditions generally favor the production of pig iron at a low cost. The cost of mining the ore seldom exceeds $1 per ton, and the cost of producing iron is not much in excess of $10 per ton. Foundry iron is the chief product of the furnaces.

The present production of pig iron amounts to about 25,000 tons per month. This is divided as follows: Roane Iron Company, 12,000 tons; Dayton Coal and Iron Company, Limited, 9000 tons; Citico Furnace Company, 4000 tons. The furnaces of the Southern Steel Company, now in bankruptcy, at Battelle, Ala., Chattanooga, Tenn., and Rising Fawn, Ga., are not in operation.

Toward the close of 1908 only a slight improvement was noticeable in the iron industry of the district. However, there is promise of better times after the first of the year. The demand for iron has shown a gradual increase and this district, in common with the southern field generally, has felt the demand to a greater extent than the iron districts of the north.

Roane Iron Company

The operations of the Roane Iron Company, which are typical of the practice in the Chattanooga district, will be described. This company owns extensive ore and coal lands and limestone deposits in the immediate vicinity of Rockwood, Roane county, at which point the blast-furnace plant is situated. Two stacks are now in blast. Included in the ore lands are important deposits about 10 miles southeasterly from Rockwood and south of the Tennessee river. The map, Fig. 2, embraces the territory covered by the operations of the company. Extending diagonally across the map is a geological section of the country from Waldens ridge through the ore mines in the vicinity of Welker.

The total output of the company's mines is from 1000 to 1100 tons of ore per day, from which there is made from 300 to 350 tons of pig iron per day. With respect to the centralization of the source of supply of ore, coal and limestone, conditions are most favorable for the manufacture of pig iron at low cost.

FIG. 1. STRIPPING AT CHAMBERLAIN, OR WELKER, MINE; ORE EXPOSED AT THE SIDES AND AT THE FACE

Rockwood Orebed

The company obtains most of its ore (from 700 to 800 tons per day) from the Rockwood vein, which outcrops at the foot of Waldens ridge, as shown in Fig. 2. This orebed strikes northeasterly and southwesterly, and has an average dip of 30 deg. toward the northwest. The most productive part of the bed is included within a length of about 4 miles, the width of the ore varying from 30 in. to 4 ft. The ore has the following range of composition: Iron, 37 to 40 per cent.; silica, 5 to 8; lime, 10 to 17; alumina, 3 to 6; magnesia, 2 to 4; sulphur, about 0.2; manganese, 0.1 to 0.2; phosphorus, 0.5 to 0.7.

Slopes in Operation

There are eight slopes, all situated in the vicinity of Cardiff, now in operation. Mining is done under contract by the Brown Mining Company. The Baker slope is 800 ft. in length; here 90 men are employed and the output is 175 tons of ore per day. Cardiff slope is 1000 ft. in length, employs 75 men and produces 150 tons per day. Carter slope is 1200 ft. in length, employs 40 men and produces 75 tons per day. Patton slope is 800 ft. in length, employs 60 men and produces 100 tons per day. Wright slope is 600 ft. in length, employs 40 men and produces 90 tons per day. Prospect slope is 400 ft. in length, employs 30 men and produces 50 tons of ore per day. Evans slope is 500 ft. in length, employs 20 men and produces 30 tons per day. Clymer slope is 400 ft. in length, employs 15 men and produces 30 tons per day. In Fig. 5 is shown the tipple at one of the slopes near Rockwood. Fig. 6 shows the surface plant.

These slopes are 6x5x7 ft. high; they are all equipped with steam-hoisting plants of capacities varying from 70 to 90 h.p. The amount of water made is not large and in most cases is handled by a Knowles pump with 4-in. discharge for the first lift, and one of 2-in. discharge for the second lift. Ventilation is supplied by Cole fans of varying sizes, depending upon requirements. One shift of 10 hours is worked per day. The cost of mining varies, depending upon the nature of the ground, but may be said to be in the neighborhood of $1 per ton.

General Development and Mining Methods

The ore was originally worked by driving the slope down to the top slate (known as the north slate) at the angle of dip. Lifts, or entries, were turned off to the ore from this slope at distances of from 100 to 200 ft.; a parting here formed the north and south end of the lift. Recently, however, owing to the harder nature of the south slate, it has been found more permanent to drive the slope under the ore, although the first expense by this method is greater. Entries are driven at 100-ft. centers. On the entries, airways, or rooms, are turned up to the lift above about every 30 ft., leaving a pillar of 20 ft. between the rooms. One 15-ft. pillar is left standing half-way between lifts, and pillars 10 to 20 ft. thick are left under the lifts, being broken only by small air-holes driven through. Most of the ore is robbed from these pillars on returning.

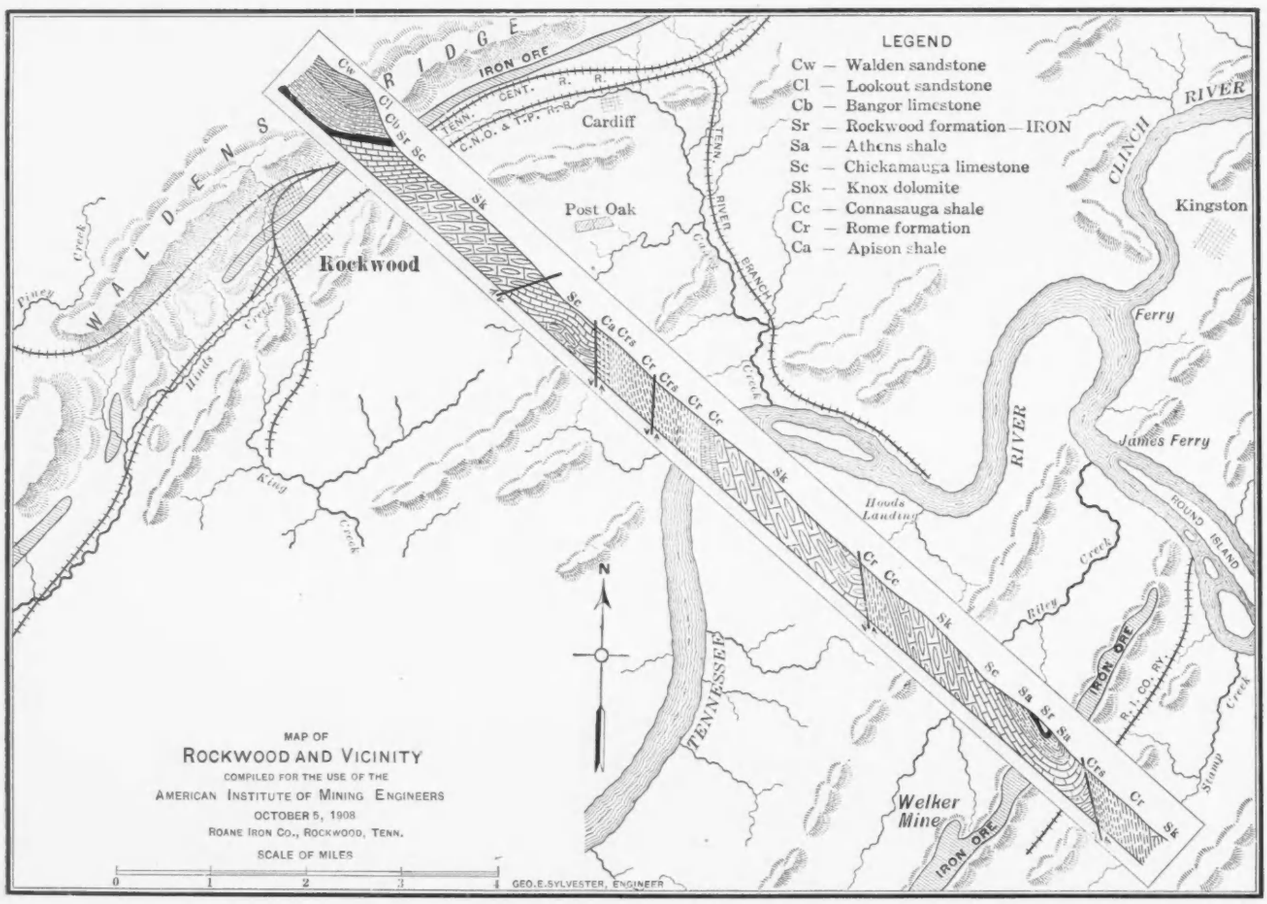

FIG. 2

Iron-ore Mines South of the Tennessee River

The company's ore land south of the Tennessee river lies in two tracts about 4 miles apart. Chamberlain, or Welker, mines (Fig. 2) are the only ones being worked to any great extent. These mines are producing about 200 tons per day of soft brown fossil ore and 100 tons of hard brown fossil ore. The soft ore has about the following average composition: Iron, 47.9 per cent.; silica, 12.10; alumina, 6.27; lime, trace; phosphorus, 0.53; manganese, 0.32. The hard ore shows the following analysis: Iron, 25.20 per cent.; silica, 3.48;

alumina, 3.25; lime, 25.20; phosphorus, 0.32; manganese, 0.15.

Here the orebed occurs in the form of a trough as may be noted in the geological section, Fig. 2. Most of the ore comes from the south end, or "upright," which is worked by driving adits from both sides of the hills until they meet; then the ore is stoped down to the country below. There are 14 openings on the "upright."

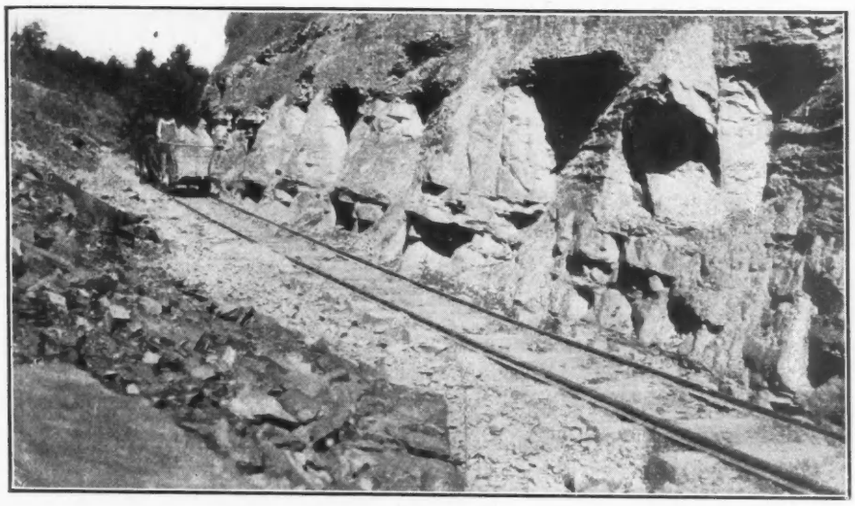

FIG. 3. A CLOSER VIEW OF THE OREBED AT CHAMBERLAIN MINE

On the north side the ore rises from the syncline on a dip of about 10 deg. The ore is stripped along the outcrop until the overburden attains a thickness of about 30 ft.; eventually, underground mining will be carried on here. This orebed, shown in Fig. 1, is about 8 ft. in thickness, and has a parting near the center of from 10 to 15 in. of slate. Fig. 3 is a closer view of the orebed, taken a short distance back of the work shown in Fig. 1.

The change from the soft to the hard ore occurs just below or at the permanent ground-water level, which in most cases is very close to the surface at the foot of the ridges. A striking example of the change is given in the stripping operation. In Fig. 1 the ore on the left-hand side of the cut is soft on top, grading into a semi-hard near the bottom. On the right-hand side, which is only a few feet lower, the ore is practically all hard.

At present about 150 men are worked at these mines. The cost of production is less than $1 per ton. The method of transporting the ore to Rockwood is interesting. The ore from the different openings is trammed to tipples and dumped into railway cars; the tipples are from 1 to 4 miles from the landing near Round Island. These cars are hauled over the railroad of the Roane Iron Company to the river, where they are loaded onto barges, and towed down the river a distance of about 8 miles to Hood's Landing. Here they pass onto the tracks of the Tennessee branch of the Cincinnati, New Orleans & Texas Pacific Railroad, going thence to the furnace at Rockwood. Fig. 7 shows two of these barges loaded with two ore cars and a passenger train. Each barge is laid with a double track and has a capacity of four carloads of ore. This passenger train is the special which left Chattanooga October 5, 1908, carrying the members and guests of the American Institute of Mining Engineers on their visit to the operations of the Roane company. The boat which tows these barges is a shallow draft stern-wheeler.

FIG. 4. LIMESTONE QUARRY AT ROCKWOOD

Coal and Limestone

The Roane company owns about 8000 acres of coal lands along Waldens ridge, of which 2000 acres are under development. The bulk of the coal is mined from slopes directly behind the furnace stacks at Rockwood. Here the seam lies in the form of a large trough, pitching into the mountain in a northerly direction. The slope is driven in the bottom of this trough on an average grade of 14 per cent. Entries are driven to right and left of the slope with sufficient grade to allow for drainage toward the slope. Where the coal shows sufficient thickness to be mined, rooms are turned right and left on such grades as to allow mule haulage. The bed varies from a few inches to 30 ft. in thickness, its average being about 4½ ft. Although nearly the whole area developed is more or less disturbed, practically all coal over 3 ft. is worked. As depth is gained under the mountain the bed becomes more level and more regular, but even here squeezes are common.

For some time ventilation at this mine gave trouble, owing to leaks through old rooms, defective brattices and fallen air courses. The mine is dry and requires regular sprinkling to lay the dust. The coal is gaseous and the workings require careful inspection. The rolls and squeezes which characterize the bed sometimes cause the shooting down of large quantities of slate in the entry work.

The coal is bituminous and has the following average composition (washed): Volatile matter, 31.07 per cent.; fixed carbon, 59.66; ash, 9.27; sulphur, 0.59. Coke from the washed coal shows the following average consumption: Volatile matter, 2.59 per cent.; fixed carbon, 83.69; ash, 13.73; sulphur, 0.56. This is an excellent grade of coke for blast-furnace work. The company has in

operation at Rockwood 350 coke ovens of the bee-hive type. The coke ovens are shown in Fig. 9. The furnaces appear in the background.

The principal limestone quarries of the company are situated about 1¼ miles southwest of the furnace, and are reached by a narrow-gage railroad. The supply of rock is practically inexhaustible. Following is the average composition: Silica, 1.94 per cent.; iron and alumina, 2.20; lime, 51.70; magnesia, 1.61. Fig. 4 shows one of the quarrying operations.

Furnace Plant

The furnace plant of the Roane company, situated at Rockwood, consists essentially of 2 modern blast furnaces, 17x 80 ft., equipped with skip hoist and modified Walter Kennedy top; 6 Macbeth blowing engines; 8 Kennedy hot-blast stoves; and boiler plant. Haulage from bins to skips is done with 4 trains of 5 side-dump cars operated with endless cable drive.

Each furnace makes from 150 to 175 tons of pig iron per day of the following analysis: Silicon, 1.50 to 3.50 per cent.; phosphorus, 1.35 to 1.50; manganese, 0.50; sulphur, 0.02 to 0.05. The furnace plant is shown in Figs. 8 and 9.

Dayton Coal and Iron Company, Limited.

The furnaces of the Dayton Coal and Iron Company, Limited, are situated at the town of Dayton, Rhea county. Here there are two stacks, 75x17½ ft., one of which is being run to full capacity. The output is about 4500 tons of foundry pig per month.

This furnace is running on Georgia brown ores and Tennessee red fossil ores. The company owns 34,000 acres of coal and iron land, the iron being in Meigs county and the coal in Rhea county.

The ores used are nearly self-fluxing; what flux is needed is quarried from the Bangor limestone deposits back of the furnace. Coal is mined near the furnaces in Rhea county. The company has 367 coke ovens at Dayton.

Citico Furnace Company

The Citico Furnace Company operates one stack at Chattanooga. The plant consists essentially of one furnace, 69 ft. high, 17 ft. bosh and 10 ft. hearth; three 350-h.p. engines; and four Whitwell stoves. The hoist is vertical and the furnace is hand-filled. The pig is handled from the casting house by a cradle of 1 ton capacity. This cradle deposits its load on a platform outside of the casting house, whence it is loaded into cars. The output is about 4000 tons of foundry iron per month. The furnace is shown in Fig. 10.

This furnace is running chiefly on custom ores, consisting of brown and red hematites. It has one red-ore mine at Citico, Ala., about 6 miles from Gadsden, on the Chattanooga Southern Railway. This mine is now under development and will soon be ready to produce a considerable tonnage. The ore has the

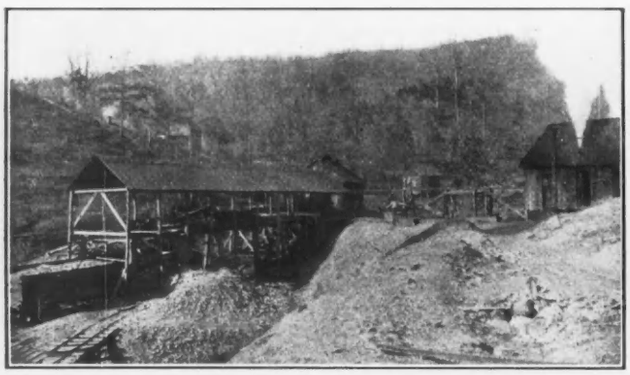

FIG. 5. TIPPLE AT IRON-ORE MINE NEAR ROCKWOOD

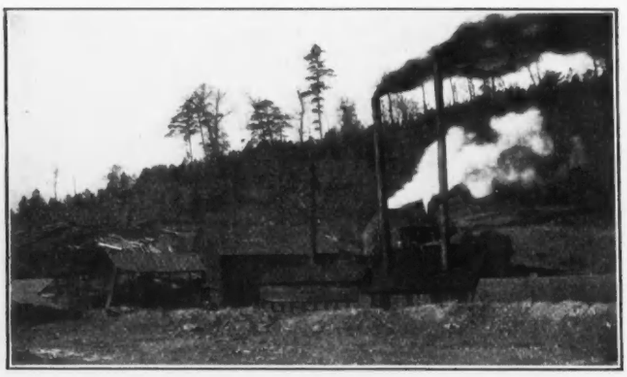

FIG. 6. SURFACE PLANT AT IRON-ORE MINE NEAR ROCKWOOD

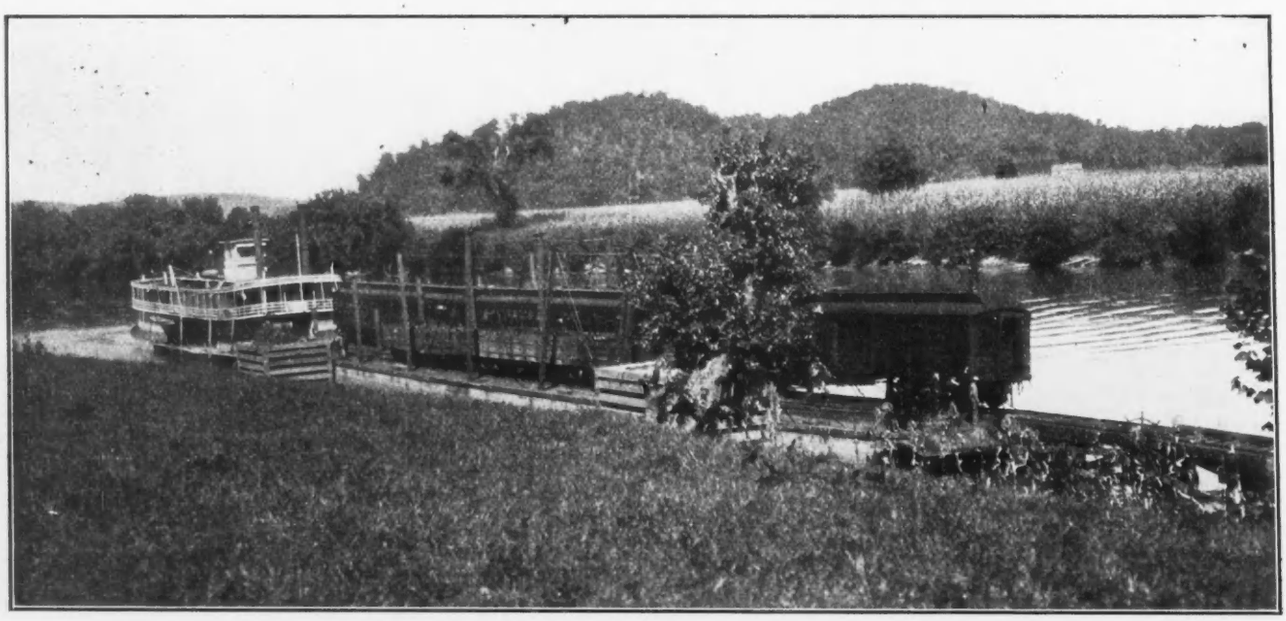

FIG. 7. TRAIN LOADED ON BARGES AND TOWED BY A SHALLOW-DRAFT STERN-WHEEL STEAMER

following composition: Iron, 40 per cent.; silica, 16; manganese, 14. The figure for phosphorus was not ascertained. Some of the ore used comes from the Tecumseh Iron Company, at Tecumseh, Ala., and from the Etowah Development Company, Queen and Crescent Railway. This is the same flux as that used at the Dayton furnace. Coke is obtained chiefly from the ovens of the New Soddy Coal Company and the Fox Coal Company, about 20 miles north of Chattanooga. The small and red ores used a mixture which is almost self-fluxing.

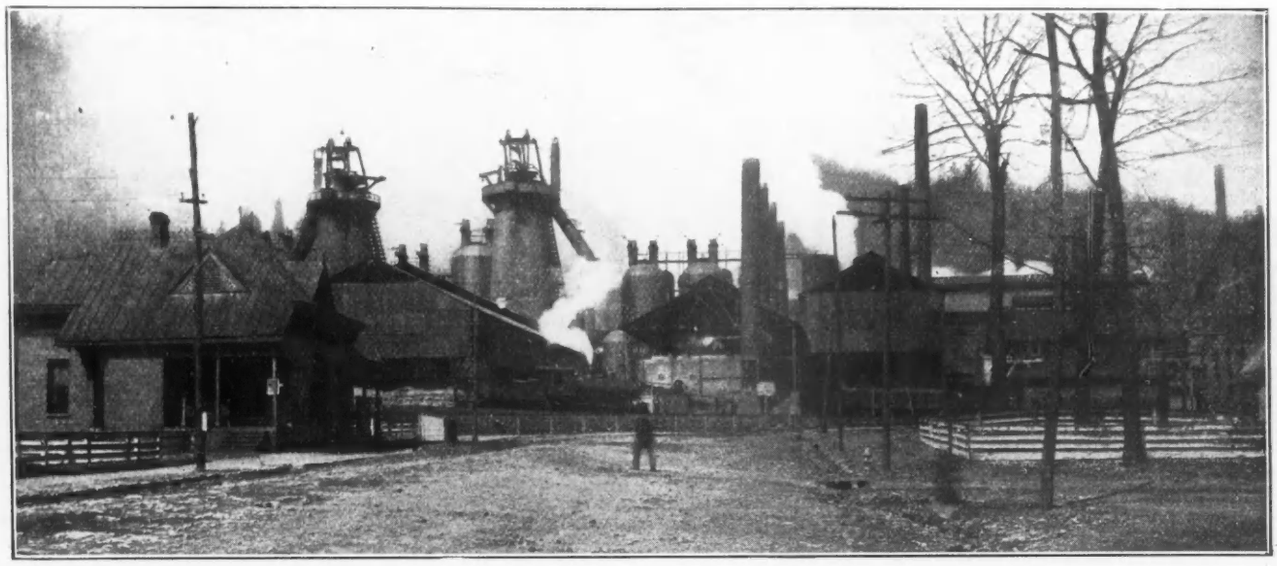

FIG. 8. FURNACES AT ROCKWOOD

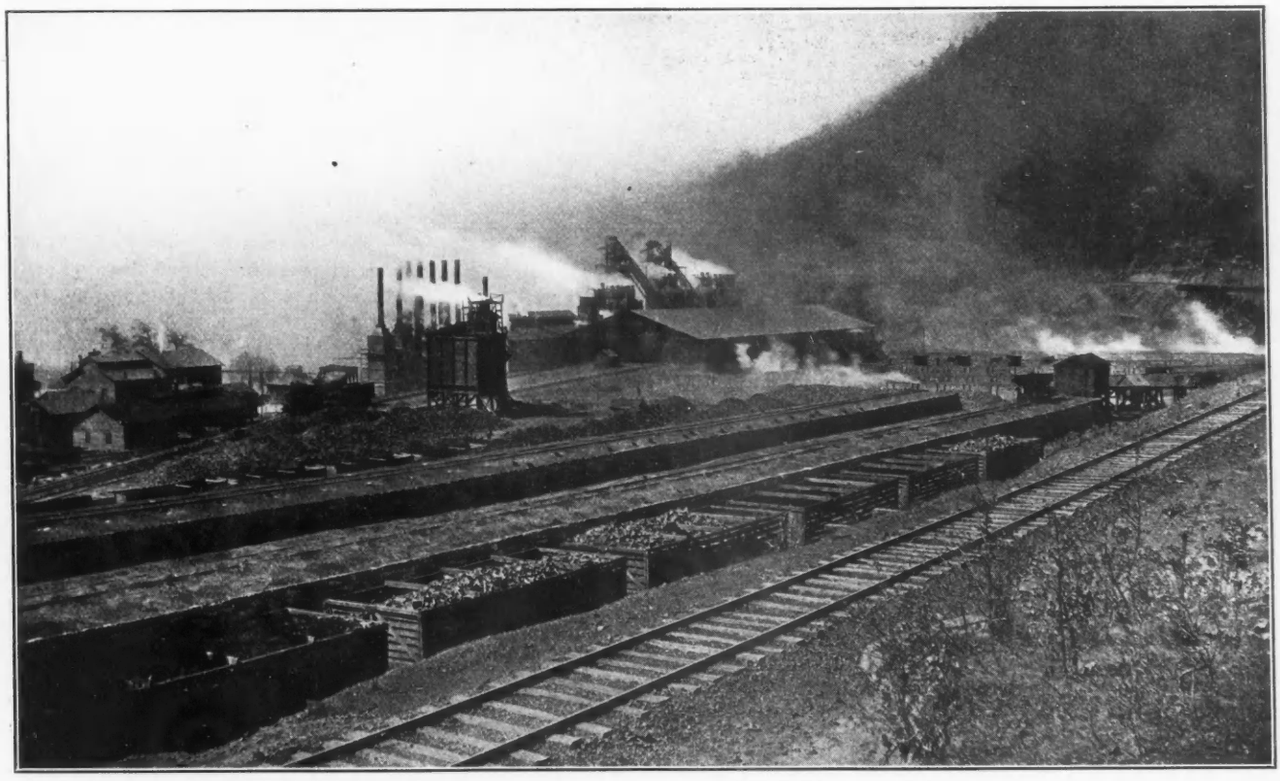

FIG. 9. COKE OVENS AND FURNACES AT ROCKWOOD

with mines at Emerson, Ga. Some ore is also shipped in from Attalla, Ala.

The limestone used comes from a point about 18 miles from Chattanooga on the balance required comes from Virginia and points west of Chattanooga in Tennessee. At this furnace little flux is required, it being possible to make from the brown

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When a shaft is sunk deeper than 600 ft. the Victoria, Australia, mining law requires that one compartment, having an area of at least 10 sq.ft., must be partitioned off and used only for purposes of ventilation, being kept clear of ladders, platforms and pipes.

The Broken Hill Proprietary Company

SPECIAL CORRESPONDENCE

This company, the head office of which is at Melbourne, Victoria, was formed in 1885 to work the well known silver-lead deposit of Broken Hill on the Barrier range, New South Wales. The capital of the company has been increased since the original issue and now stands at £384,000 in 960,000 shares of 8s. each, fully paid up. The report for the half-year ended May. 31, 1908, has recently been issued. It contains a detailed account, both technical and financial, of the operations and is accompanied with useful tables showing the fluctuations in the prices of the mine products—silver, lead, zinc and copper—for some years past, as well as plans of the workings and photographs of the new engineering workshop of the Carmichael-Bradford desulphurizing plant and of the new spelter furnace. Besides the usual auditors' certificate, the accounts are further indorsed by a certificate, signed by the secretary, which is required by the Australian companies act. This sworn certificate gives particulars as to the capital of the company, stating how much of the share capital is paper and how much has been actually paid up in money. A detailed list of the assets and liabilities is also included, together with particulars of the investments securing the reserve and insurance funds. The names, addresses and occupation of the directors are also stated in full. The compulsory publication in Australia of so much explanatory detail, as regards the accounts and the financial position generally, is a practice that might be followed with advantage to shareholders by the directors of many mining companies in England and the United States, who often issue reports which contain but meager information as to the financial position of the undertakings they direct.

The most important event in the period under review was the completion of the first unit of a spelter plant at Port Pirie. The first trials have been satisfactory, and the directors have decided to erect a plant capable of producing 8000 tons of spelter yearly, at an estimated cost of £100,000.

The sales of the company's products in the East are expanding. For the half-year ended Nov. 30, 1906, the sale of lead to India, China and Japan amounted to 4537 tons, while for the six months ending May 31, 1908, the sale was 9777 tons. The total sales for the six months were 35,085 tons, of which 21,486 tons went to Europe and 3822 tons were sold to Australia and New Zealand.

Experiments have been made with the Carmichael-Bradford process for roasting concentrates, on different lines from experiments made in former years. A new plant has been put up at a cost of £3300, capable of dealing with 200 to 250 tons a day. A feature of this plant is that, instead of using coal, the only combustible material used is straw, at the rate of about 10 lb. straw to one ton of concentrates. The Port Pirie smelting works carried on operations with nine furnaces. Three of the furnaces have been rebuilt in order to raise the water-jackets, a step made necessary by the more intense blast from the turbo-blower. The tonnage treated was as follows:

	Tons Treated.	Per-centage.
Kaolin and silicious ores (including purchased ores)	10,968	10.02
Sulphide concentrates and slimes	72,195	65.94
Sintered slimes	26,319	24.04
Total	109,482	100.00

In addition there were re-treated 5784 tons of flue-dust and refinery dross.

The refinery dealt with 37,133 tons of bullion, producing 2,102,559 oz. fine silver, 796 oz. fine gold, 36,140 tons soft lead and 335 tons antimonial lead. The doré plant treated 28,610 oz. doré bullion producing 796 oz. gold. As a result of a visit to America, the general manager, Mr. Delprat, erected a small experimental bag-house for filtering the smoke going to the stack. It has been found that the losses of lead in this direction had been considerable. The experiments have been encouraging and a bag plant estimated to cost £3500 is to be erected. The material gathered in the bags is chiefly sulphide of lead, which burns readily into a well sintered product, containing about 70 per cent. lead and practically no silver.

Owing to the low price of metals, the company's operation resulted in only the small net profit of £22,776 as compared with £137,642 for the previous half-year. The price of lead averaged £12 10s. 11d. per ton and silver 27.9375d. The low price of metals and the small profits earned call for a revision of the rate of wages. The present agreement with the workers expires on Dec. 31 next, and unless the metal markets improve before that date a reduction in the rate of wages will probably be demanded.

As regards the ore-dressing mills it is only necessary to remark that the use of tube mills for re-grinding is extending. Two tube mills of an improved pattern, with four Wilfley tables, have been installed, and two more are in course of erection, while eight additional mills with further improvements are shortly expected from Europe.

The centrifugal pumps for raising slimes, tailings and water are being replaced by bucket elevators, a considerable saving in power and repairs being thereby effected.

The ore-dressing mills treated 262,165 tons of crude ore during the six months. As regards the mine the position is reported to be satisfactory. The deepest level—1400 ft.—has been opened up, the orebody showing at first 6 ft. of fair ore, but at a point 50 ft. to the north it suddenly widened out to 44 ft. of high-grade sulphide ore. The bottom levels—1300 and 1400 ft.— have not yet been systematically sampled, but bulk samples indicate an average value of 16.18 per cent. zinc, 20 per cent. lead and 14 oz. silver.

Part of the mine is still on fire, but the fire is, however, at present well under control, and the directors consider that no serious apprehension need be felt that any interference with the general work of the mine can take place. The expenditure on account of the fire has amounted to £40,000 in all.

The fortunes of the company are dependent, of course, on the prices of zinc, lead and silver. With lead at £13 per ton and silver at 20d. per oz., it is not possible to cover working expenses under present conditions. A revival in the world's trade is required for the prosperity of the company.

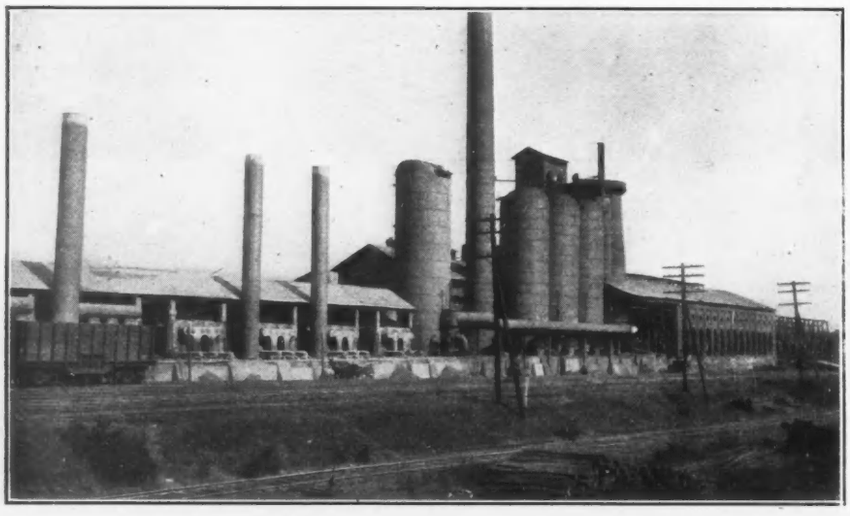


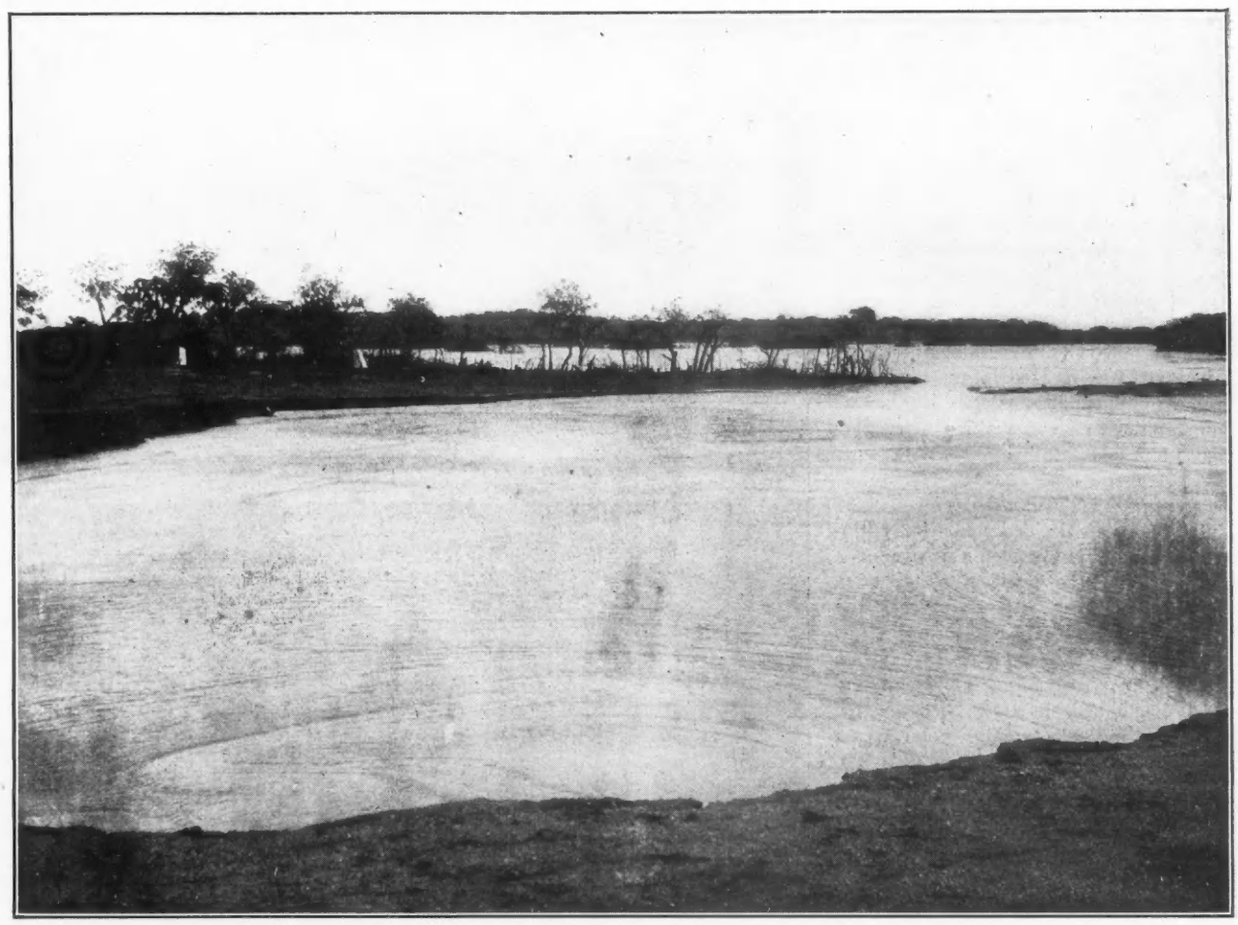
FIG. 10. FURNACE OF CITICO IRON COMPANY, CHATTANOOGA

S. Pearson & Son's Uncontrollable Oil Gusher

San Diego de la Mar Well No. 3, near Dos Bocas, Which Burned for Nearly Two Months and Defeated All Efforts to Save the Oil

SPECIAL CORRESPONDENCE

During last summer press despatches in the newspapers reported the progress of a series of attempts on the part of S. Pearson & Son to gain control of a remarkable burning oil well opened near Dos Bocas, Mexico, in one of the extensive operations of that firm. When news came on Sept. 1 that the fire had been extinguished, it was generally supposed that the company's engineers with the aid of a battalion of troops supplied by the Mexican government had gained control of the well; the force of the gusher was then far from exhausted. The violence of the outflow continued to increase until on Nov. 1, when all efforts to save the oil had to be abandoned.



LOOKING FROM THE HIGHEST POINT ON THE EDGE OF THE CRATER TOWARD THE OUTLET. DISTURBANCE NEAR OPPOSITE SHORE ON THE LEFT, CAUSED BY FLOW FROM THE WELL

The San Diego de la Mar property is situated in the northern part of the State of Vera Cruz, about 75 miles by water from Tampico, on the Tamiahua lagoon. The lagoon is separated from the Gulf of Mexico by a narrow strip of land less than a mile in width. The subsoil rights to the lands were leased in 1901 by the Pennsylvania Oil Company, of Mexico, an American company, and a well was drilled on the property at a point on the lagoon known as Dos Bocas, but without result. In 1907 the English firm of S. Pearson & Son, Ltd., acquired the controlling interest in the Pennsylvania Oil Company, of Mexico. The first well drilled on the estate by the Pearsons came in at 2005 ft., with an estimated production of 5000 bbl. of oil daily.

San Diego well No. 3, the second well drilled by the Pearsons, came in on July 4, 1908, at a depth of 1824 ft. The drilling for some time prior to the blowout had been in the hard marl, when all at once it passed into soft shale. This created no surprise on the part of the driller, as similar soft shale formations had been encountered in this same well, and he continued to "make hole." After having made about 3 ft. in this formation the internal pressure began to exert itself, coming back through the 4-in. drill stem and bursting the hose. When this happened the driller remained at his post, raising the stem a considerable distance in the well, thinking that possibly it might be only a gas blowout and would soon be over. It gradually became stronger, however, and within 15 to 20 minutes the well was flowing at the rate of about 12,000 bbl. daily, causing the ground round the well to tremble considerably and to open up in several places. One of these fissures was immediately underneath the boiler, having started by first throwing out gas and then coming in oil. The fissure suddenly burst into flame, the fire working its way toward the well. A strong breeze was blowing, which made it

impossible for the men to get between the boiler and the well. The fire ignited the gas coming from the well, and simultaneously the whole country surrounding the well was enveloped in a mass of flames. The flow of the well increased in strength and volume until it was making between 75,000 and 100,000 bbl. of oil daily.

Effects of the Blowout

At the time of the blowout there were 43 ft. of 11⅝-in. casing and 1283 ft. of 8-in. casing in the hole. About half an hour after the well caught fire the pressure increased to such an extent that the drill stem was blown out of the hole, through the top of the derrick, to a hight of 150 ft., where it bent over like a piece of rubber tube and fell to the ground. The whole 1825 ft. of 4-in. drill stem was blown entirely out of the well.

On July 13, nine days after the fire started, the hight of the flames was estimated by engineers to be 1500 ft. At a hight of 800 ft. the flames were 90 ft. wide, all of the oil being consumed in the flames. The fire could be seen 200 miles at sea from the Gulf of Mexico. At night a newspaper could be read by the light of the fire 20 miles away. The noise of the fire was rather muffled, somewhat like the roar of Niagara falls. Monster volumes of black oil vapor or smoke would be picked up and rolled over and over again in the flames up to 1500 ft. and more into the air. When it was gushing at its strongest the well was making more than 100,000 bbl. of oil daily.

Extinguishing the Fire

The first plan decided upon for extinguishing the fire involved the use of a drag made of the heaviest plates of a 2000-bbl. steel tank, riveted together and weighted down with 30 tons of rails, this to be dragged over the hole with steam winches and wire cable. This plan had to be abandoned, however, because the orifice became too greatly enlarged, a crater apparently having formed.

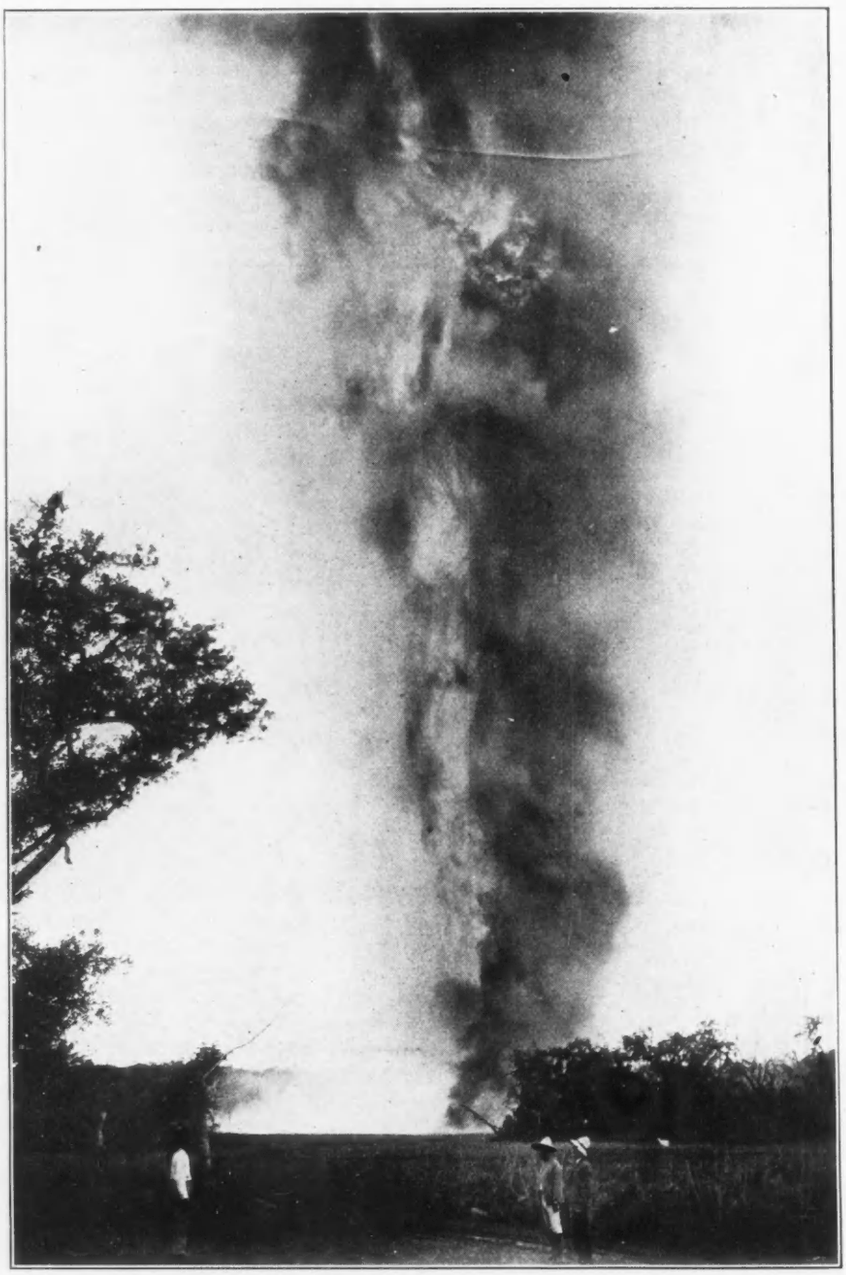
The second plan adopted was to sink an inclined hole at an angle of about 45 deg., with the idea of intersecting the burning well at about 300 or 400 ft. from the surface, when a charge of nitro-glycerin was to have been inserted and discharged, with the idea of choking off the flow of oil. On July 17 the well tore itself loose, form an immense crater. The solid column of flame began to weaken, and a part of the oil fell to the ground, burning in the "ciénaga," or marshy land, on the edge of which the well was situated, forming a lake of fire about 300 ft. wide round the well. On July 25 the crater was more than 150 ft. in diameter, the great area of the opening making it necessary to abandon the project of drilling angle wells.

It was then decided to install centrifugal pumps and to pump sand and gravel into the crater to choke the well. This was carried into effect, and on the night of Aug. 30, after having burned for 57 days, the fire was extinguished, the gushing in the meantime having become intermittent, at times ceasing almost entirely. It was during one of these periods when the pressure was weakest that the fire was extinguished by the continued caving, aided by the sand and gravel pumped into the crater.

On Oct. 1 the flow from the well was estimated to be about 3,000,000 bbl. of water and 15,000 bbl. of oil daily.

Attempts to Save the Oil

The Mexican government sent engineers and an entire battalion of 450 sappers to aid in extinguishing the fire and in saving the oil from the well. The battalion



THE BURNING OIL WELL NEAR DOS BOCAS, MEXICO. THE COLUMNS OF FLAME AND SMOKE ROSE TO A HIGHT OF 1500 FEET

Three weeks after the fire was out the diameter of the crater was 400 ft. Soundings taken 30 ft. from the sides showed a depth in places of 200 ft. Approximately two acres of earth dropped into the crater at one time. The immense flow of water and oil had forced an outlet into the Tamiahua lagoon, and for miles the surface of the water was covered with oil. of sappers remained at San Diego until Nov. 1, when the continued caving of the crater made it necessary to abandon entirely the plans for saving the oil.

The work of building dikes, sluices and earthen storage reservoirs for saving the oil has been surrounded with great difficulties. Fully one-third of the working time was lost due to the noxious gases

from the crater, the fumes making it impossible for the men to work when the wind was from the west. Excessive heat and mosquitoes added further to the difficulties.

The plans for saving the oil were based upon a careful study of the conditions and an estimate of the probable future behavior of the well. On Sept. 12 it was believed that the caving of the sides of the crater and the flow of water, mud and oil might soon be limited or interrupted by natural causes. The record kept during the sinking of the well shows that at 330 ft. hard rock was struck, and no change in record until 422 ft. was reached, indicating a stratum of rock approximately 100 ft. thick. It was believed that the opening through this stratum must be restricted, because the hard rock would resist erosion better than the looser *choy,* or marl, which was carried out of the well in immense volumes by the water. The solids in the mud ejected from the crater amounted to 17.06 per cent. by weight and 6.81 per cent. by volume.

quenching the flames by rendering the flow so intermittent that the oil on the surface had time to burn itself out before a fresh outburst from below could supply additional fuel; but it failed to control the flow permanently. No plan could take sufficiently into account the enormous forces which developed as the caving of the crater progressed.

Plans for Storage

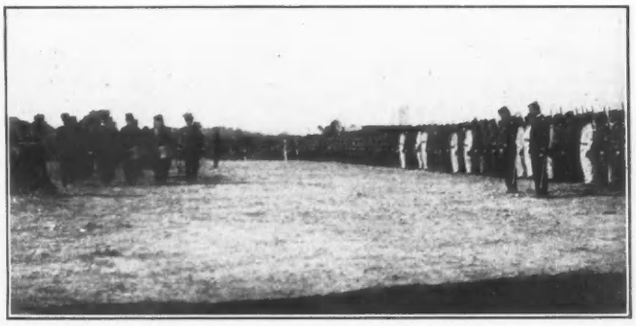
The ingenious plan adopted for saving the oil was based upon the reasonable assumption that the 100 ft. of rock, 330 ft. down, would hold the bore to fairly narrow dimensions, and that the caving of the sides of the crater would, therefore, cease. Hundreds of men and many mule teams with scrapers were set to work to throw up a dike inclosing the opening. A flume with a suitable gate was to be built at the surface to draw off the water and mud into the lagoon while the layer of oil, which was expected to separate in the crater itself, was to be drawn off at a higher elevation into storage reservoirs. But the walls of the well continued to cave and the flow to increase. Apparently the hard stratum at 330 ft. had been undermined and was breaking up. Finally the fumes from the well became so serious and the crater encroached upon the earthwork to such an extent that the well had to be abandoned.

Beyond Hope of Control

The following extract from a letter from one of the engineers on the ground dated Oct. 12, suggests the helplessness of engineering science when confronted with the extraordinary forces manifested in this remarkable gusher:

"Every morning we wake up wondering what new phase of the situation will force the adoption of changes in our plans, or the inauguration of new measures. The bigger the hole bores out the more water comes; and the more water comes, the greater the quantity of solids thrown up. I saw the well belch yesterday up to a hight of 30 ft. beyond the normal surface and over an area as big as the patio of the office building. If the water continues to come under the same pressure as formerly, and such seems to be the case, more water is but a question of the enlargement of the orifice through which it reaches the surface, and this orifice is periodically enlarging itself by washing away and caving in the walls of the well. As fast as they cave in the water conveys the cavings to the *cienega* and the lake.

BUILDING DIKES FOR STORAGE OF OIL



BATTALION OF SAPPERS SENT BY THE MEXICAN GOVERNMENT

If the opening in the hard stratum at 330 ft. remained fairly restricted the width of the crater at the surface would be limited by a definite angle. The caving banks contained a certain amount of gravel in addition to the loose material floated out into the lagoon. It was believed that this gravel might settle and choke the well at the narrow orifice long enough for the finer *choy* to settle and form a temporary plug in the well.

Another hard stratum of rock was encountered by the drill at 1128 ft., and it was believed that much of the enormous volume of solids carried out of the well was derived from the soft strata between this and the hard rock nearer the surface. The second plan for plugging the well contemplated sinking an inclined well to the bore in the upper hard stratum and then choking the opening by shattering the rock with explosives. The third plan for controlling the flow involved the introduction of thousands of tons of gravel into the conical crater by means of powerful centrifugal pumps. This plan was successful to the extent that it extinguished the fire, or at least aided in

Some idea of the enormous forces at work in this remarkable well may be gained from the estimates of the flow. While the daily flow on Oct. 1 was approximately 3,000,000 bbl. of water and 15,000 bbl. of oil, on Nov. 1, when the well was finally abandoned, the total volume had risen to 14,000,000 bbl., the oil being thoroughly emulsified with water and mud. On Sept. 12 the oil ejected from the well covered an area of about 20 sq.m. on lake Tamiahua. On Oct. 12, the approximate volumes of solid matter carried from the well into the San Geronimo river and into lake Tamiahua was from 30,000 to 50,000 cu.m. At that date a captain of a steamer plying these waters reported that the wheel of his vessel stirred up *choy,* mud and asphalt four miles off the mouth of Dos Bocas.

"Where this condition will stop no human being can predict, but if the pressure continues to come as the orifice opens, cavings will continue indefinitely. The force that is moving the immense volume of water outward must be expended before this well will permanently choke itself.

"The oil flow since the cave of last night has been almost *nil,* but it is entirely possible that it is so heavy with *choy* emulsion that instead of floating it sinks, and passes outward in the lower levels of the flowing stream, in some places 6 ft. deep, and running at the rate of 4 ft. per second.

"After every heavy caving the oil comes in heavy emulsion and gradually clears itself to pure oil as the well purges away the cavings. The periods when pure oil has been flowing have been very few and of short duration during the past 10 days. While I believed that the cavings would become greater as the arch in the perimeter of the well flattened, I never believed that they could become as rapid as they have in the past week or so, and the water flow is carrying away the cavings as rapidly as they come in."

The Rare Metals, VI —Titanium

By Charles Baskerville*

Titanium is almost invariably present in igneous rocks and in the sedimentary material derived from them. It occurs in soils and clays, and 784 out of 800 igneous rocks analyzed in the laboratory of the United States Geological Survey contained titanium. The titaniferous minerals, which seldom occur in considerable quantity in any one locality, are named in the accompanying table. However, extensive deposits of titanium ores are known.

TITANIUM MINERALS.

	Titanium Dioxide Content.
Rutile, titanium dioxide	90–100%
Edisonite, a variety of rutile	
Iserite, a variety of rutile	70%
Dicksbergite, a variety of rutile	90–100%
Brookite, titanium dioxide	90–100%
Octahedrite, titanium dioxide	90–100%
Ilmenite, iron titanium oxide	3– 59%
Titanite, calcium titanium silicate	35– 45%
Pseudobrookite, a ferric titanate	44– 53%
Perofskite, calcium titanate	59%
Geikielite, magnesium titanite	68%
Senaite, composition uncertain	57%
Zirkelite, a titanic thorio-zirconate of iron and lime	15%
Knopite, a titanate of calcium, iron and cerium	54– 59%
Derbylite, a doubtful iron, antimony and titanium oxide	34.5%
Lewisite, a titano-antimonate of iron	11–12%
Mauzeliite, a titano-antimonate of lead and calcium	7– 8%
Neptunite, a titano-silicate of iron and alkali metals	17– 18%
Hainite, a silicate of sodium, calcium, titanium, etc	
Polymignite, a niobate and titanate of cerium, iron, etc	19%
Aeschynite, a niobate and titanate of the cerium metals	21%
Pyrochlore, chiefly a niobate of the cerium metals, etc	5– 14%
Dysanalyte, a titano-niobate of calcium and iron	40– 60%
Rinkite, a complex silicate of titanium, calcium, etc	13%
Mosandrite, a complex silicate of cerium, etc	5–10%
Johnstrupite, a complex silicate of cerium, calcium, etc	7– 8%
Astrophyllite, an orthosilicate of titanium, etc	7– 14%
Lamprophyllite, composition doubtful	
Keilhauite, a titano-silicate of calcium, yttrium metals, etc	26– 37%
Schorlomite, analogous to garnet	12– 22%
Guarinite, calcium titanium silicate	34%
Tscheffkinite, uncertain composition	16– 21%
Euxenite, a niobate and titanate of yttrium, uranium, etc	20– 35%
Polycrase, a niobate and titanate of yttrium, etc	25– 30%

The important titanium minerals are rutile, brookite, octahedrite, perofskite, ilmenite and titanite.

Uses of Titanium

The addition of titanium in minute amounts to iron and steel increases the tensile strength greatly; ferro-titanium is useful in cases where a metal of considerable density and hardness is required, as in the manufacture of car wheels. Titanium steel is employed for cutting tools. The addition of titanium to steel containing 0.8 to 1.2 per cent. of carbon scarcely increases the hardness, but greatly raises the elasticity. On account of the beautiful light effect it produces during combustion, titanium has been used in pyrotechnics. It is also used in the manufacture of filaments for incandescent electric lamps, and for incandescing media for gas lights. With the development of the electric furnace treatment there will be a market for titaniferous iron ores.

Titanium dioxide has been used for some time in the manufacture of artificial teeth, and in the preparation of a glaze for earthenware; more recently it has been employed as a mordant for wool and cotton. Titanium mordant yields bright and fast colors intermediate in shade between the colors produced by chromium and aluminum. Titanium dioxide has also been utilized in the manufacture of a protective paint for iron and steel. Titanium sesquioxide and its salts are employed as reducing agents, sodium titanous sulphate and titanous chloride having been found most useful. Titanium tannate may be utilized as a self-color for fibers or the material may be further dyed with basic coloring matters. Titanium oxalate, potassium titanium oxalate, "tanno-potassium titanium oxalate," and the double tartrates and lactates of titanium with alkali metals are used in leather dyeing. Titanium ferrocyanide is employed as a substitute for the poisonous Schweinfurth green and other arsenical pigments.

Rutile

Rutile, or nigrine, occurs in reddish brown to nearly black prismatic crystals, which are often acicular in form and as such included in other minerals. It is found occasionally massive, especially when black and ferriferous. Rutile occurs as a pyrogenic mineral in eruptive rocks, but is more common to gneiss, mica schist, and the phyllites. It also is found as a secondary mineral derived from ilmenite and titanite. Rutile is a brittle mineral, having a hardness of 6-6.5, and a specific gravity of 4.18-4.25. Its luster is adamantine to almost metallic, and the cleavage is prismatic and pyramidal. The streak is pale brown. It is found in Maine, New Hampshire, Massachusetts, Connecticut, New York, Pennsylvania, New Jersey, North Carolina, Georgia, Arkansas, Colorado, and in the Black Hills, Dakota. The most prominent of these localities are Lincoln county, Ga., Habersham county, Ga., Warwick, N. Y., Warren, Me., and Magnet Cove, Arkansas.

Rutile is infusible before the blowpipe. It dissolves very slowly in salt of phosphorus in the oxidizing flame to a yellowish bead, which assumes a violet color in the reducing flame on cooling. Ferriferous varieties give a brownish yellow or red bead in the reducing flame, so that a violet color is only obtained after treating the bead with metallic tin on charcoal. It is insoluble in acids. However, it dissolves by fusion with an alkaline carbonate; the solution, after the addition of an excess of acid and tin-foil, yields a violet color on boiling.

Rutile is of a more decided red color and of lower specific gravity than cassiterite; and may readily be discriminated from garnet, pyroxene, vesuvianite, and tourmaline by its luster, weight and infusibility.

Brookite

Brookite is found in thin, tabular, brown crystals, or in black opaque crystals, habit varied, in the Ozark Mountains, Ark., North Carolina, Ulster County, N. Y., and at Paris, Me. Its hardness is 5.5-6, and the specific gravity is 3.87-4.07. The luster is submetallic to adamantine, and the streak may be uncolored, gray, or yellow. Arkansite, as the variety from Magnet Cove, Ozark Mountains, Ark., is called, occurs in stout crystals, brown to black in color, associated with elaeolite, black garnet, schorlomite, and rutile, to which it alters on the surface by paramorphism. At Ellenville, N. Y., brookite is found on quartz with galena.

The pyrognostic deportment of brookite is the same as rutile.

Octahedrite

This mineral occurs in light brown, deep blue and black pyramidal crystals at Smithfield, R. I., and Brindletown, N. C. At the latter locality, it is found in transparent tabular crystals. The luster of octahedrite is metallic to adamantine, and the fracture is subconchoidal. It is brittle, and the hardness is 5.5-6 and the specific gravity is 3.82-3.95. The streak is white. Octahedrite is never primary, but is formed by the alteration of other titanium minerals.

Octahedrite behaves like rutile before the blowpipe. Its specific gravity increases to about that of rutile on heating.

Perofskite

Perofskite, or perovskite, occurs in pale yellow to grayish-black cubic crystals and in reniform masses. It has been noted as a rock constituent in the form of very small octahedral crystals. It is found in Elliott county, Ky., and at Syracuse, N. Y. The hardness is 5.5, and the specific gravity is 4.01-4.04. The luster is adamantine, and the streak is colorless or grayish. It is transparent to opaque.

Perofskite is infusible before the blowpipe. With salt of phosphorus it dissolves readily in the oxidizing flame to a greenish bead while hot, but which becomes colorless on cooling; in the reducing flame the bead assumes a violet-blue color on cooling. It is decomposed by sulphuric acid, but is insoluble in hydrochloric acid.

Ilmenite

Ilmenite, menaccanite, or titanic iron-ore, is an iron-black mineral, which is found usually massive, in thin plates, in embedded grains, or loose as sand. It occurs in Orange county, N. Y., Massachusetts, Litchfield, Conn., Troy, Vt., and

*Professor of chemistry, College of the City of New York.

in California. Extensive beds of ilmenite occur in Quebec, Canada. Its hardness is 5-6, the specific gravity is 4.5-5, and the luster is submetallic. The fracture is conchoidal. The streak is black to brownish red. Ilmenite slightly influences the magnetic needle.

Ilmenite is infusible in the oxidizing flame, but is rounded on the edges in the reducing flame. It reacts for iron with borax and salt of phosphorus in the oxidizing flame, and yields a brownish-red bead in the reducing flame with the latter salt; this changes to a violet-red color when treated with tin on charcoal. The powdered mineral is soluble in hydrochloric acid to a yellow solution, which assumes a blue or violet color when boiled with tin. It is decomposed on fusion with sodium or potassium disulphates.

Ilmenite is distinguished from magnetite and hematite by the titanium reactions described above. It is used in the preparation of a lining for puddling furnaces, but is not very desirable as an iron ore on account of the difficulty in reducing it.

Titanite

Titanite occurs in brown, gray, yellow, green, rose-red, and black, wedge-shaped or tabular monoclinic crystals. It is sometimes found massive, and rarely lamellar. The luster is adamantine to resinous, and the streak is white. The hardness is 5-5.5, and the specific gravity is 3.4-3.56. It occurs in Maine, Massachusetts, Trumbull, Conn., Lake George, N. Y., Franklin Furnace, N. J., Bucks county, Penn., and in Iredell, Buncombe, and Alexander counties, N. C. At Green River, N. C., large crystals of sphene, or titanite, occur completely or partially altered into xanthitane. Good gem stones of titanite have been found at Brewsters, N. Y., Bridgewater, Penn., and Magnet Cove, Arkansas.

Before the blowpipe, some varieties change color, becoming yellow, and fuse to a dark glass with intumescence. Titanite gives a violet bead with salt of phosphorus in the reducing flame. The borax bead is clear yellow-green. It is partly soluble in hydrochloric acid, and if the solution is concentrated after the addition of tin, it assumes a violet color. It is completely soluble in sulphuric acid.

Aluminum Coins in France

M. Caillaux, French Minister of Finance, is shortly to place before the Chamber a bill in which he proposes to replace the small old-time copper coins by new coins of aluminum. He has had some aluminum coins struck at the mint, which have met with approval. The new 5- and 10-centime coins are to be of exactly the same size as the copper coins now being used, the only difference being in weight.

Zinc Mining in New Jersey *

By Henry B. Kummel†

The zinc mines at Franklin Furnace and Ogdensburg, both controlled by the New Jersey Zinc Company, are the only mines of this character in the State, and during 1907, as for a number of years past, only the Franklin deposit was worked, the mines at Ogdensburg having been indefinitely closed down a number of years ago. The richness of this ore, the great size of the orebody and the large rewards awaiting the discoverer of additional deposits, have led, first and last, to the expenditure of large sums of money in prospecting the adjoining territory. The zinc deposits occur only in the white crystalline limestone, the limits of which are accurately known. It is safe to say that every foot of this belt has been carefully examined on the surface without revealing any evidence of additional deposits. In addition to this thousands of dollars have been spent in diamond drilling on all sides of the known deposits, but without avail. It is unquestionably true that in some instances the drilling ceased before the ground had been thoroughly tested, i.e., before the holes reached the bottom of the limestone, but since the holes were in some instances at least 1300 or 1400 ft. deep, it was demonstrated that no zinc deposits occurred within easy reach of the surface where they were drilled. The absence of any surface indications of zinc ore, and the utter failure of all the drilling to reveal a deposit other than those which have been mined for many years, afford at least very strong presumptive evidence that no other deposits exist. And, while there is always the possibility that zinc ore similar in character to the Franklin ore may occur somewhere within the limits of the white limestone, yet the probabilities of finding it by a few diamond-drill holes put down at random are so remote that any exploration of that character must be regarded as a highly speculative venture in which the chances are against success. It seems advisable to make these emphatic statements in view of the large sums of money recently obtained by a mining company on the alleged occurrence of valuable zinc deposits on property adjacent to the established mines.

The New Jersey Zinc Company reports its production in 1907 as 329,205 tons of ore, a little less than half of this having been taken from the open cut at the south end. This is a decrease of 32,120 tons as compared with 1906. The Palmer shaft, started in 1906, enters the blue limestone of the footwall, near the mill, at an angle of 47½ deg. At the close of the year, it had been sunk 580 ft. and was in the gneiss underlying the white limestone. Since the blue limestone and associated sedimentary beds dip to the westward at an angle of about 50 deg., the shaft crosses the bedding planes nearly at right angles. The gneiss was reached 230 ft. from the collar of the shaft, and from that point to 580 ft. and beyond the rock was gneiss, the foliation and fracture planes of which dip eastward at an angle of 70 degrees. At 402 ft. from the collar of the shaft, a small vein of zinc blende, which dipped about 50 deg. to the west, was struck. It measured from 1 to 3 in. in width and was associated with quartz and fluorite.

[The emphatic remarks of Doctor Kümmel are highly praiseworthy and ought to do much to prevent the inception of fraudulent and visionary schemes such as have frequently been dangled before unwary investors in the past. This is an exemplification of one of the highest functions of a State geologist.—Editor.]

*From Annual Report of the State geologist for 1907.
†State geologist of New Jersey.

Pulverized Shale for Prevention of Coal Dust Explosions

Experiments at Lieven, France, in the laboratory maintained by the Comité Central Des Houilliéres de France, recently demonstrated the value of a new explosive, "grisoutine couche," to overcome the danger of secondary explosions of coal dust, and also that coal dust mixed in the proportion of six to four with pulverized shale cannot be exploded. A gallery constructed of armored concrete fitted with protected glass observation holes was used to show the progress of explosions. Nothing has yet been said about the industrial value of the discoveries, as some experiments have yet to be made in order to discover to what extent local applications of shale dust will prevent explosion.

The laboratory is making experiments with apparatus of all kinds intended for preventing disasters in the mines, or for making it possible to inaugurate intelligent relief work very soon after any disaster has occurred. Among the specialties of the laboratory is a department for testing and mending anemometers which are used for recording the draught caused in different parts of the mines by the ventilating fans.

In Victoria, Australia, the State mining law requires 70 cu.ft. per minute of air to be supplied to each miner working in the mine and that the air in the mine shall not contain less than 20 per cent. oxygen, nor more than 0.3 per cent. carbon dioxide. The Western Australian Mining Commission in 1905 considered that not more than 0.15 per cent. carbon dioxide should be allowed and that it should not be difficult for mines to meet that demand. Dr. Angus Smith, of the English Mining Commission, recommends 0.24 per cent. carbon dioxide as the limit of impunity in mine air.

Views Respecting Coal Mine Explosions

Engineers Discuss Statements of Mr. Haas, Mr. Page and JOURNAL Editorial of Dec. 12, Relative to Colliery Accidents, Cause and Prevention

A SYMPOSIUM OF OPINIONS

The following letters, including the longer article by Mr. Stow, have been written in reply to recent arguments advanced to explain the chief causes of coal-mine explosions. The authors differ radically in some of their views; however, it is only through the fearless expression of such personal opinions that the maximum benefit will result.

Blown-out Shots and Miners' Negligence Cause Many Explosions

By Carl Scholz*

I have read with interest your editorial in the issue of Dec. 12, on "Colliery Accidents." If you will compare the accidents which existed prior to the adoption of the mine-run basis, or when coal was mined in this country very much on the same basis as it is now produced in England, Belgium, Germany and France, which countries are held up as examples, you will note that our accident ratio then was very much lower than it is now. While Mr. Mitchell stated that 60 per cent. of the fatal accidents are due to rock falls, it is well known that increased rock falls are due to excessive use of explosives and shooting from the solid.

The Mine Workers' organization has been forcing the majority of the mining fields to use the mine-run basis, and in some sections this has resulted in the adoption of mining machines to prevent excessive waste. Even if not a single explosion could be prevented, but I think they can, if we could reduce the accidents from rock falls to one-half by cutting the coal before blasting it, the greatest possible step in the direction of saving lives and preserving the coal will have been made. There might have been some good reason to adopt the mine-run basis, but once it is proved to be detrimental, it seems to me that the mine workers should be willing to change their attitude.

In talking with a number of officials, I find that, individually, they are favoring the readoption of pick mining, and it seems to me this will place a premium on the good miner and force out of the mines such men as are not qualified to be miners and are a menace to the safety of their fellow employees.

Electric shot-firing is a great safeguard and shot-firers reduce the risk to a smaller number of men, although as long as the coal was properly mined and undercut, there was no necessity for this course. Blown-out shots generally result where coal is not properly mined, or where it is shot from the solid; there is no excuse for blown-out shots where mining machines are used and the coal is properly snubbed. Solid-shooting is responsible for an increase in the cost of production and requires the consumer of domestic coal to pay the greater part of the expense. In coking-coal districts, this feature is not of as much importance as in territories where domestic coals are produced and where the small coals command lower prices, as is the case in Illinois and Indiana.

Why should the operators be compelled to go to the expense of inspection and installation of expensive apparatus, when the miners, merely as the result of a fad, continuously and daily force the assumption of risk of life and property?

*Mining engineer, Chicago, Ill.

Facts Disproving Recent Statements Relative to Mine Fatalities

By Joseph Virgin*

In reference to the article of Wm. N. Page in your issue of Dec. 5, Major Page says, "After a careful study of the Paper of Mr. Haas and the Report of Foreign Experts, etc.," two facts seem to be established: 1. That dust as dust is not explosive. 2. It is physically impossible to moisten dust to the point of safety in high velocity currents. After a careful study of Mr. Page's paper, and the other papers mentioned by that gentleman, as well as your editorial of Dec. 5, six facts seem to be established: First, dust in a quiescent state is not explosive. Second, dust is not quiescent in a high velocity. Neither is it quiet after a slight concussion, such as accompanies falls of roof, or the concussion from shots or moving trains. Third, Mr. Haas is an advocate of fine spray moistening with water or steam, or any method that is convenient, and is practicing it. Fourth, Messrs. Watteyne and Meissner concur in this. Fifth, the statement that 66 per cent. of all mining fatalities are due to roof falls, is not borne out by figures, especially West Virginia, and more especially in that same State for the years ending June 30, 1905, 1906, 1907, and 1908. Sixth, moisture in the air does not seem to be a particular cause of the fatalities in West Virginia or Pennsylvania.

As to the first consideration, fine dust in a quiet state is not explosive because it is *en masse*. You cannot get a flame around it, neither is there enough oxygen around it to make a flame with it. But upon the least provocation it is stirred up and is surrounded by its own atmosphere of air and Professor Abel says it will ignite at 700 deg. F. Such being the case, it is immaterial whether it detonates, bursts into flame or explodes; the result is the same, the men are killed.

Concerning the second fact, dust won't stay quiet. You may shut down your fans and let all the dust settle, but just as soon as you start them up again the dust begins to move; furthermore, the air acts on the rocks, and falls occur, forcing the very finest and the most dangerous dust out on any flame that may be near; the dust is also disturbed by any movement of cars, and the high velocity of rope trips or motor trains causing the gauze of safety lamps to be clogged, making them pass the flame at a much less velocity, thereby greatly intensifying the danger.

Third, Mr. Haas not only advocates steam and fine sprays to moisten dust in high velocities, but is contemplating a long steam line to warm the winter air to assist it in getting the moisture from the sprays or steam more quickly. However, if you clean up the dust and do not allow it to accumulate, you will not have any dust to water, and it will only be necessary to keep the fine coal damp so that it can be removed before it becomes dust.

Fourth, at the meeting of the West Virginia Mining Association, Doctor Holmes and the foreign experts gave us strong advice on the good results to be obtained from watering, and the results of the investigation tests in Europe.

Fifth, let us take the West Virginia reports for the years 1897-1907, inclusive; the following results are shown:

Total lives lost	1699	
Falls of roof, coal, etc.	928; 54 per cent. was due to falls of roof, etc.	
During 1905, lives lost	176	
Due to falls of roof, etc.		105
During 1906, lives lost	250	
Due to falls of roof, etc.		99
During 1907, lives lost	324	
Due to falls of roof, etc.		139
	750	343

Take the year ending June 30, 1905, we find 50 lives were lost in all kinds of

*Mine superintendent, Plymouth, West Va.

explosions. Then for the year ending June 30, 1906, we find 113 lives lost from the same cause. In the year ending June 30, 1907, there were 147 lives lost from mine explosions.

FATALITIES IN WEST VIRGINIA

	Tota Lives Lost.	By Explosions of All Forms.	Due to All Kinds of Explosions.
1905....	176	50	28 per cent.
1906....	250	113	45 per cent.
1907....	324	147	45 per cent.
1908....	will probably show		60 per cent.

As Mr. Page's open letter was directed to the mine managers of West Virginia, Mr. Page being an operator in this State, his figures are somewhat misleading. Mr. Paul, in his report for 1907, to the Governor of West Virginia, makes the following statement: "For the third time in the history of the State, the number killed by explosions exceeds that of persons killed by falls of roof."

The elaborate report of the Pennsylvania mining department for 1904, and covering the bituminous mines of the State, shows that the loss of life due to falls of roof, was 37.98 per cent. Again referring to the last mentioned report, for the year, 1904, I submit a few figures to show that moisture as appearing in the summer months is no more dangerous, from a standpoint of lives lost, than when occurring in the colder months.

FATALITIES IN PENNSYLVANIA

Month.	Killed by Falls of Roof and Slate		
Dec.....	20		
Jan.....	14	47	Cold months, least saturation.
Feb.....	13		
March...	14		
April....	20	57	Slightly warmer months, a little more moisture.
May.....	23		
June....	13		
July....	19	53	Extremely warm months, highly saturated.
August..	21		
Sept....	12		
Oct.....	19	48	Normal temperature, average humidity.
Nov.....	17		

In the years 1905, 1906, 1907, ending June 30, I produce the following from the West Virginia Mine Reports:

MEN KILLED BY FALLS OF ROOF FOR THE THREE YEARS.

Month.	Total Fatalities.		
Dec.....	32		
Jan.....	26	88	Winter months.
Feb.....	30		
March...	17		
April....	23	64	Spring months.
May.....	28		
June....	17		
July....	25	64	Summer months, most moisture.
Aug.....	22		
Sept....	24		
Oct.....	21	64	Fall months, normal temperature.
Nov.....	19		

All the figures gleaned from the bituminous mine reports of Pennsylvania and those of West Virginia, prove that as far as the mines of those two States are concerned, that the months in the year containing the most moisture are not particularly dangerous; in fact West Virginia seems to be safer in the hot months.

The foregoing figures also disprove the statements that 5 per cent. of our accidents are due to dust explosions, and 66 per cent. to falls of roof. Mr. Page probably means all kinds of mines, not coal mines alone. In conclusion, I desire to approve of the policy of keeping dust damp and using large currents of air. West Virginia allows only 60 men in each split, and it follows, therefore, that in a mine of 300 men, there must be 5 splits, or the law is violated, consequently, it appears that Mr. Page's advice to split, is ancient.

Timely Suggestions as to Shot-firing in Coal Mines

By R. J. J.*

I have read with great interest your editorial of Dec. 12, on "Colliery Accidents," also the description of the events connected with the Marianna explosion. I am glad to note your reference to the action of the National Institute of Mine Inspectors, at the Pittsburg meeting of the Mining Congress. The inspectors, as a rule, are underpaid, if one considers the character of their duties, and should be encouraged in their work rather than censured. The press bulletins issued during the past year may have been necessary in order to influence public sentiment so that appropriations for the work of the Federal Technologic Division would be forthcoming; however, I believe that they have tended to throw an air of mystery around mine explosions in the minds of the general public. We all know that mine gas and air will explode; there is no use to erect expensive apparatus to demonstrate this fact, but we do not know just what explosives at present on the market are safe, and the investigation of such substances, by the Survey authorities, is to be commended.

THE EMPLOYMENT OF SHOT-FIRERS IS ADVISABLE

As to the employment of shot-firers, I believe that you have not grasped the full significance of Mr. Mitchell's remarks. I have not read his address, and can only gain an idea of what he said as you refer to it. He doubtless refers to the Illinois Shot-firer's Law. This was necessary, as the inspectors found that explosions were becoming more frequent. They reasoned that it would be better to employ shot-firers to shoot the shots than to allow the miners to shoot their own shots. These shot-firers would shoot the holes when they were alone in the mine, after all the miners had left the workings. Since the adoption of this plan, there have been numerous small explosions, many of them undoubtedly due to powder poorly placed in the holes, and a number of the shot-firers have been killed. Had these explosions taken place under the old rule of allowing every miner to shoot his own shots, when the entire force was in the mine, the loss of life would have been in many cases, I venture to assert, at least as great as that in the Marianna explosion.

As it was, only the shot-firers, of which there are rarely more than 6 or 8 in number, and usually but 2, were lost. It seems to me that the Illinois law, so far as it has been enforced, is a good one, and should be extended to other States. But, it has its imperfections. Usually, active men are required for the work of shot-firing, as the men must be able to quickly traverse the entire mine workings in order to shoot all the shots in a short space of time. For this reason the older and more experienced miners will not do the work, and it is often relegated to younger and less experienced men; often, indeed, to drivers, who are proverbially prone to take chances. Moreover in some cases, the practice has been to allow the shot-firers a shift's wages for shooting a certain amount of shots, and, as a consequence they have hurried through the work, sometimes taking reckless chances which resulted to their sorrow. This is not general, but such cases have occurred. However, this is the fault of the men, not of the system, and where it is wisely carried out, it will prove in the end a life-saving innovation.

PROBABLE CAUSES OF EXPLOSIONS

One thing that has been a source of wonder to many, is why we are of late years, having more and more explosions, where we never had any before, and where the method of mining is the same as it has been for 30 to 40 years past, and the men are experienced in the system used. I refer more especially to solid-shooting mines. Is it because the general run of miners are not now as skilled as formerly, or is it because the powder manufacturers now use different ingredients in their powder, than they did formerly? In support of the first question, I have recently heard of instances where the shot-firer found cartridges placed for him to shoot, which were longer than the hole was deep. As to the second question, the use of an ingredient with greater flame-producing powers than that formerly employed might cause explosions.

Another factor which I think is neglected, is the element of time. Formerly, the men fired their shots under the ten-hour day custom, anywhere from 4:30 to 6 p.m. Now, under the eight-hour day, the shots are fired nearly all in the

*Mining engineer, Baltimore, Md.

space of time varying from 15 to 30 min., or from 3 to 3:30 or from 4 to 4:15 or 4:30 p.m. Many more men are now employed to produce a given output than was formerly the case, and more powder is used per ton of coal than formerly; all this powder is exploded in from 15 to 30 min., where shot-firers are not employed, and occasionally when they are, although the time formerly required for such work was from two to three hours. The liberation of such a great volume of gas from powder explosions in such a short space of time, may be a contributory cause.

As to the Marianna explosion, you do not say so, but I presume that there was indiscriminate shooting, that is, the men fired when they wished, at any time during the shift, and not at the close of the shift, as they should. Perhaps this was the case also at Monongah.

Now from your sketch I note that there was no wide work under way at the Marianna mine at the time of the explosion, all the men being engaged in driving headings. If such was the case, and the coal was thick, say 8 to 10 ft. in thickness, and the narrow entries were passing a large current of air at a high velocity, the only factors necessary for trouble was the presence of some gas, a coal making a fine dust, and some entryman shooting a gripping shot. The large volume of air at a high velocity would accentuate the explosive force of the powder on the air. If some men were working ahead of the air, and the entryman and crosscutman fired at the same time, an explosion might easily result. I have known of such instances. Incidentally, I believe that no man should be allowed to work "ahead of the air;" the distance between the crosscuts between entries should be established and rigidly adhered to, and the mine foreman or inspector should be allowed no option in the matter. Brattice work is all right, but a good crosscut is better.

As bearing on the question of intelligence of miners and frequency of accidents, I would refer you to the Maryland coalfields, where, in 1907, the death rate per 1000 employees was 0.64. Some 6201 miners are employed and over 1,000,000 tons mined for each fatal accident. Moreover most of the coal worked is quite thick, and a poor roof covers the coal, so that the miner must use great care in his work. It is also true that no gas is encountered in the mines. The miners are nearly all Americans of a high order of intelligence. The inspector and companies in most cases work in harmony, and there is good discipline in the mines. The above is presented for your consideration, as it may lead to some changes in the present system of shot-firing in use in portions of Pennsylvania. The attention of those who compare the death rate in American mines with those in European countries, is directed to Inspector Murphy's reports for Allegheny and Garrett counties, Maryland, for the past three years.

High Currents in Mine Ventilation

By W. C.*

It is most disgusting to read and hear the flow of "rot" that is being spread over the land, as to mine accidents and their prevention. The whole question resolves itself into one of candor or hypocrisy. The men who know most about the subject are thrust into the background, and if they say anything it is drowned by bellowings of mediocrity.

Accidents don't happen in pits where people are looking for them, but generally in those workings where the best management is said to prevail. Throughout the entire world the highly gaseous mines are well looked after. The new craze that pits are getting too much wind, is simply an endeavor to justify those who have too little, and who wish to continue to work dangerous mines with open lights.

It is perfectly true that in the case of ignition a vigorous current of air lends force to the blast; it is also true that the air can be so split and directed that its velocity will be kept down to a safe limit, in working places. No one will deny that a vigorous air current will remove the finest particles of dust; but they will be deposited in wide places in returns, where they constitute far less of a menace to safety than they do while they remain in the main haulways and the chambers that are being worked.

Dust as a Factor in Mine Explosions

By C. S.†

I note in your issue of Dec. 5, the letter written by William N. Page, on "Dust as a Factor in Mine Explosions," and also note your editorial comment on the Marianna explosion. I concur with you in your analysis of Mr. Page's letter, especially that part referring to the increased rock falls due to the introduction of moisture, having given this subject close attention for two years.

In the first place the accidents due to rock falls occur at the face of the rooms and are due either to careless timbering, or excessive use of explosives; the effect of the moisture, where it is noticed in mines, occurs on the intake entries. I have found, however, that where the air is fully saturated constantly, the rock falls in the summer are not nearly so great during the sweaty season; the change from wet to dry causes disintegration of rocks and decaying of wood, whereas if constantly submerged or kept dry, this material is not affected by the action of the atmosphere. What applies to rock outside, undoubtedly applies in the mine as well, and it is noted that such places in the mines as have seepages throughout the year usually have a better roof.

The increase in humidity in the winter months in my opinion is by far the most effective measure to prevent, or at least diminish explosions. In machine mines care should be taken to load out the cuttings, and it is possible that one spray should be used in the rooms which are cut just before shooting, in order to remove the flying dust from the air current.

One or two accidents which have occurred recently, have been in mines that produced practically no gas, and it is almost safe to assume that the explosions were due entirely to the dust in the air. In mines where shooting from the solid is practiced, the excessive use of explosives creates much flying dust; as a whole, the mining conditions today are quite different from what they were, say fifteen years ago, when all of the coal was undercut, whereas it is now either shot from the solid or mined by machines. These two modern practices have brought about a change in the mining conditions, the importance of which is perhaps not appreciated, because the changes were made gradually.

*Mining engineer, Pennsylvania.

†Mine manager, Chicago, Ill.

The Control of Coal Mine Explosions

By Harvey J. Nelms*

In your issue of Dec. 5, you print an article by Wm. Page, of West Virginia, on "Dust as a Factor in Mine Explosions." In my experience with coal mining, as a mining engineer, I cannot believe that the fatal accidents resulting from falls of slate are caused by the disintegration of the slate by water. The faults in coal seams, such as clay partings, etc., generally denote a wet entry, and I am sure superintendents of coal mines will agree with me in saying that 75 per cent. of the fatal accidents due to falls of slate, etc., may be explained by the old text, "death due to error of judgment on the part of the injured in setting post wrong." As to splitting air currents, etc., I cannot regard this plan as being a possible preventive of the so-called dust explosions.

Dust Only Ignited by Firedamp

In a mine which generates firedamp in dangerous quantities, I am sure the smaller factor of the two to guard against is dust. We know what gas will do if allowed to reach a proper mixture, while dust is only dangerous when the firedamp sets it off. I cannot believe that a dust explosion will take place when started by anything but a firedamp explosion.

Everybody working in coal mines knows

*Mining engineer, Bentleyville, Penn.

of entrymen who work from 10 to 100 ft. ahead of the air, although their entry is making gas, and they have 10 or 12 small explosions each day. It is reasonable to believe that once in a while the dust will be so distributed and in proper condition to explode when started by a firedamp explosion. In controlling the ventilation of coal mines, I believe the vapor and so-called wetness or dryness of the air, making up the air currents, should be tested at several places in the mines; by this I mean that if we go on the theory that coal dust will explode when conditions are favorable, then it appears to me that the proper thing to do is to keep the mines from getting in a condition where the dust will be dangerous. In the first place, the miner should not be allowed to load the slack coal made by a mining machine in one car. A room 23 to 27 ft. wide, and cut 6 ft. deep usually makes just a 2-ton car of slack, the slack filling the car bed full. It often occurs that as soon as the room is cut the miner will load this slack all in one car and by transporting this car to the outside by mule and locomotive power, the dust will impregnate the air as the car passes along the entries.

I believe a better plan would be to load half the slack and then fill the car with loose coal, the latter more or less protecting the air from the slack. It is also advisable that trips should not be hauled at a speed exceeding 10 miles per hour when the mines are very dusty. These are but a few suggestions showing the practical side of controlling coal dust.

I do not altogether believe in Mr. Hass' theory of steam, although steam used for wetting the air currents in coal mines is far better than sprinkling. I feel sure much good will result if we act on the supposition that the only thing to do to prevent coal-dust explosions, is to keep the atmosphere of the mines always in the same condition and not allow any change of atmospheric condition, due to sudden changes of temperature outside, such as the difference between winter, summer, etc. If ventilation is not in any way stopped, and if we keep the absolute amount of water vapor in the air currents always the same, never allowing them to change, then coal dust will not and cannot explode, because as long as these conditions are observed, the chemical reaction necessary for a coal-dust explosion cannot occur.

All Air Currents Should be Regularly Tested

It is a simple operation to measure the amount of water vapor in a given quantity of air, and it seems to me all coal superintendents would be making a good investment if they would install a small testing station at their mines, so tests could be made three or four times a day. The mine manager could be kept informed of the condition of the atmosphere in the different plants under his care, and when the water vapor fell too low, steam could be admitted to the intake air until the mine atmosphere would again come up to the proper standard. As long as the air in the mines is kept at one standard, as regards water vapor, the coal dust will be a minor factor and will not explode. Swift air currents are the best, as they will not deposit their water vapor as fast as slow-moving currents. An aspirator and drying tubes are the only devices necessary to measure the amount of water in a ventilating air current.

Practical Methods for Testing the Air

One plan is to fill a jar with water, the jar having a stop cork at the bottom; U-shaped drying tubes are also filled with pumice stone soaked with sulphuric acid. The stone is carefully weighed before the experiment, and when the stop cock is turned on and the water is allowed to run out of the jar, this draws an air current through the drying tubes. The volume of air which passes through the apparatus can be found by measuring the water that has run out of the aspirator, and the weight of water in this volume of air can be found by again carefully weighing the pumice stone. The difference in weight between the first and second weighing of the pumice stone gives the weight of water contained in the volume of air which passed through the drying tube.

Another and easier way to test the air is to get some Ca CL_2, and place it in a saucer; this attracts the water out of the air, the salt gradually becomes wet and eventually dissolves in the water which it attracts from the air. If taken every morning a person would soon notice any difference in the amount of water contained in the air and could remedy the condition by adding steam if too small, and reducing velocity of air currents, if too much. The standard condition of the vapor in the air should be previously determined by careful investigations, the first and foremost idea being not to allow any change to take place in the condition of the mine air as regards the amount of water contained in the air currents.

We are not going to find a new theory or system for working our coal mines, and consequently, we must make the best use of the knowledge we already possess.

Using a Booster Fan

Mr. Page is wrong in his theory of providing several fans of smaller capacity. If the main fan outside has too much work to do, it can be easily helped by installing an 8- or 10-ft. fan of the Stine type 3000 or 4000 ft. in along the main return airway, providing, of course, that the outside fan works as an exhaust. This booster fan should be operated electrically and belt connected preferably by a three-phase, 440-volt induction motor, if the alternating current can be got. This motor gives the least amount of trouble on the market, and will operate under most severe conditions for any speed at which it is rated. The speeds usually vary from 150, through nine speeds, to 600 r.p.m.; the motor being belt connected and running the fan at any desired velocity. These fans, when installed, give most excellent satisfaction. The main fan under these conditions works only from the exhaust of the inside fan.

Splitting air currents and the liberal use of overcasts will be most helpful to any mine. It may here be mentioned that the recent coal-mine explosions have only occurred in those mines under the care of the so-called and high-priced expert. The small fellows manage to get along without paying for explosions. It may be well for some of the others to take notice.

Ventilation Is a Question of Quality Rather than Quantity

By P. J. D.*

Mining engineers were no doubt surprised at the proposition advanced by A. B. Fleming of West Virginia, at the recent meeting of the American Mining Congress at Pittsburg. Mr. Fleming then said: "I wonder sometimes if there is such a thing as too much ventilation in the mines?" This question seems to have arisen in Mr. Fleming's mind for the reason that recent mine explosions have occurred in workings that were supposed to be among "the best ventilated in the world."

Our Mines Do Not Get Too Much Ventilation

The speaker, and those who apparently agreed with him according to newspaper reports, appears to have overlooked the fact that the reason especially elaborate ventilation installations exist is that mines so equipped are (in the majority of cases) known to be dangerously gaseous, and therefore liable to be the scene of explosions. It is a strange conclusion, however, that in such cases the cause of explosions lies in the fact that there is too much ventilation. It is much more likely that the ventilation, though perhaps unusually good, was still not good enough, or that gaseous workings were not properly ventilated, even though the mine as a whole was amply supplied with air. Explosions most often occur when the barometer is low, for the reason that the explosive gases are liberated from coal in larger quantities whenever the atmospheric pressure falls, and the greater the volume of air that can be supplied by fans, the more gases are diluted and the smaller the chance of an explosive mixture being formed.

It would seem that Mr. Fleming's doubt

*Mining engineer, New York City.

should have been directed not so much at the existence of too great an amount of ventilation, as at ventilation of a particular kind. Experience and the writings of experts on such matters may be searched in vain for rules against "too much" ventilation. Ventilation is not a question of quantity, but of quality, and that there is room for improvement in ventilation admits of little doubt.

The suggestion made above that explosions are likely to occur in gaseous workings, even though at the same time the rest of the mine is well supplied with fresh air, is borne out not only by general experience, but it is the point especially dwelt upon by the most recent writers on this subject. Speaking of the prevention of coal-mine explosions, W. B. Williams, in the ENGINEERING AND MINING JOURNAL of April 18, 1908, says: "The only remedy in the first instance will be proper ventilation; for this purpose I believe that the splitting of the air at each cross or room entry is the best system to follow, making crosscuts between entries and rooms as often as necessary to carry the air to the working faces at all times."

President William N. Page, of the West Virginia Mining Association, has also had something to say on this subject recently (ENGINEERING AND MINING JOURNAL, December 5, 1908). Mr. Page thinks that so far as the prevention of dust explosions is concerned, slowing down the ventilating currents to a velocity at which they will not carry dust in dangerous quantity, is the most effective measure against the dust danger. It is evident, however, from Mr. Page's following remarks, that what he believes in is not less, but better ventilation. He says:

"The tendency heretofore has been to regulate by statutes the specified volumes of air per minute for each man, animal and light, without any limit beyond the statutory specifications; the mine inspectors have all considered high velocities as the most desirable attainment, the higher the better, with an eye single to firedamp and pure air for the miner. It seems to me, however, that the time has come when the law makers and mine experts should study consequences, as too much of any good thing must always be harmful.

"Instead of forcing 200,000 cu.ft. of air per minute through restricted airways and passages by a single fan, under sufficient pressure to permeate every part of a tortuous mine, necessitating high velocities in many passages, I would suggest that the current be split as often as possible, and a number of auxiliary fans be substituted for one powerful single unit. Five fans delivering 40,000 cu.ft. will be preferable to one delivering 200,000 cu.ft., not only because of the slower velocities, but from an actual saving of power through less friction. Such small units placed within the mine will operate as force and suction at the same time, and since electricity is now almost universally employed underground, there is no mechanical or other difficulty in the way of installation. The cost of the small units combined will be little, if any, greater than a single unit of equal capacity.

"Where there is more than one intake and outcast, there is no problem involved, and in shaft mines with limited entrance, the difficulties would be neither great nor costly, as the necessary intake and outcast where the velocities might be high, could be easily isolated from all danger. In other words, the currents could be passed through auxiliary fans and slowed down, just as an electric force can be stepped up or down through a rotary converter. With such an arrangement, a uniform volume of air, under slow velocity, could be more satisfactorily distributed across all working faces, and a small motor-driven fan could be moved from place to place, with little loss of time or money."

With the introduction of comparatively small centrifugal fans of the turbine type, the ventilation of mines in such a way as that recommended by Mr. Page no longer presents the insuperable difficulties that existed in the days when the Guibal fan was the best known means of mine ventilation. Among other advantages of the newer types of fan, their speed and output can be nicely regulated in accordance with especial demands. There appears, therefore, as has been said above, no reason for fearing "too much" ventilation. There is, however, reason to demand ventilation that will not merely supply a fixed volume of air, but which will be adapted to the special requirement of given mines, and be so arranged as to reach those parts of mines that are especially dangerous, instead, as often happens at present, of being mainly confined to areas of the mine that perhaps need no ventilation at all to prevent gas or dust explosions.

Explosions in Coal Mines

BY MEL BUTLER*

Some time ago in these columns I expressed the belief that it was impossible for mechanical devices alone to make coal mines free from explosions. The recent disaster at Marianna, where every effort had been made to perfectly equip the plant mechanically, and where the property was known as the "model" mine, further confirms my opinion.

Improved living conditions will not immediately produce more intelligent and responsible people. The standard of the coal-mine worker has for years, been going lower, and it will require years to make an appreciable general improvement.

It is hard to understand why so many coal-mining companies will spend any amount of money for equipment to make the mines safe and to reduce costs, but will not put on shot-firers, allowing indiscriminate firing by all miners regardless of their experience. Prevent "blown-out" shots, and mine explosions will rarely occur. Certified fire-bosses, mine-bosses, engineers and superintendents do not prevent explosions, and alone, never will; the unions have not accomplished anything in this respect, being solely absorbed in the membership list and the collection of dues.

Apprenticeship is the system required to make better mines and thereby safer miners; this, and being required to pass a suitable examination before a certificate is issued, will teach them what should be done, as well as what should not be done, to prevent explosions, and also reduce the number of accidents at the face. I sincerely hope to see something on these lines before long.

*Mine superintendent, Seattle, Wash.

Patent Legislation in Washington

SPECIAL CORRESPONDENCE

At an important meeting of the House Committee on patents on Dec. 12, the subject of patent legislation for this session was considered in executive meeting with the Commissioner of Patents. It was determined to prepare and place before Congress a bill relating to the so-called "manufacturing question." Specifically the bill is to provide some means for encouraging the manufacture of goods protected by American patents in the United States. In case foreign owners of American patents manufacture exclusively abroad the goods protected by such American patents it is designed either to provide for the forfeiture of the patent rights, or else to leave the maintenance of the patent rights to private litigation making it a special defense against infringement to show that the goods protected by American patents are not produced in this country, but are exclusively manufactured abroad.

New Zealand Production

The Mines Department states the exports of gold from New Zealand for the nine months ended Sept. 30 at 382,081 oz. bullion in 1907, and 390,442 oz. in 1908; an increase of 8361 oz. The bullion reported this year was equal to $7,515,258, or 363,583 oz. fine gold. Silver exports for the nine months were 1,207,389 oz. in 1907, and 1,238,317 oz. in 1908; an increase of 30,928 oz. The silver comes chiefly from the gold mines of the Ohinemuri district.

Is Coal Dust, as Such, Explosive?

A Study of the Chemical Reactions That Occur in Dust Explosions, and a Percentage Estimate of Fatalities Due to Falls of Roof and Side

BY AUDLEY H. STOW*

Of all the perplexing questions that have puzzled the minds of the most intelligent observers, at one time and another, dust and dust explosions, probably compare quite favorably in the number of widely diverse, and often clearly contradictory theories that have been advanced, for the solution or explanation of the various phenomena accompanying these occurrences.

In attempting to forge a chain of deductions, to prove a certain theory, or to contravert the opposition theory, one of which must be wrong, we only too often find that there is a missing link, and that we lack the necessary information to arrive at a definite conclusion, thus leaving the adherents of the two theories secure in their loyalty to their views.

The amount of evidence to prove that dust, in the absence of all gas, has exploded, on almost numberless occasions, seems amply sufficient to settle the question; yet it is also claimed by many, at least this is the impression, that dust is not explosive, *per se*. We now have in addition Mr. Haas' theory that dust, as such, is not explosive. This appears rather a technical distinction, interesting it is true, but not clearly having a practical bearing on the question as to whether dust is, or is not explosive.

It is not quite clear from the arguments in support of the last-mentioned theory whether it is conceded that explosions have resulted from dust in which no firedamp was present, or whether the position is taken that a dust explosion is an impossibility, in the absence of all gas, as such, immediately prior to the instant of ignition. However this may be, the line of argument advanced in support of this addition to the already long list of our theories on dust, is one of some interest, and appears to admit of being carried still farther, although unfortunately we lack the necessary information to reach a definite conclusion, thus leaving the result still a matter of personal opinion.

The quantities used by Mr. Haas are substantially correct, for the purpose, although somewhat different values appear more nearly correct, at least in regard to the relative weights of air and coal, if we are to use the point of maximum explosive force.

The relative quantities will also depend on whether we assume that the fixed carbon does not take part in the reaction, or whether we assume that the dust is entirely consumed. In many dust explosions the deposits of coke are certainly extensive, yet it will be assumed for the present that such deposits are due to the lack of air, or the excess of dust, as may be preferred rather than the inability of the fixed carbon to take part in the reaction.

The Reactions that Occur

Again, the relative quantities will depend somewhat on the variety of coal under consideration, more particularly in regard to the per cent. of volatile matter. As the exact chemical structure of coals is far from having been exactly determined, we will assume certain structures that agree, near enough with observed results.

If the coal has such a structure that when subjected to destructive distillation, it yields 3 atoms of fixed carbon and 1 molecule of methane, we have, disregarding the ash, 31 per cent. volatile matter and 69 per cent. fixed carbon.

Air may be considered as 1 atom of oxygen, and 4 of nitrogen; we thus have:

Coal. Air.

$$C_4H_4 + 10(o) + 40\,N = 4\,co_2 + 2\,H_2o + 4\,ON$$

$$52 + 720 = \text{Sum of atomic weights}$$

or 1 part by weight of coal to 13.84 parts by weight of air.

If we assume that the coal consists of 6 atoms of fixed carbon to 1 of CH_4 we have 82 per cent. fixed carbon and 18 per cent. volatile matter, exclusive of ash.

Coal. Air.

$$C\,H_4 + 16(o) + 64\,N = 7\,co_2 + 2\,H_2o + 64\,N$$

$$88 + 1152 = \text{Sum of atomic weights,}$$

or one part by weight of coal to 13.09 parts of air.

J. T. Beard, in his "Mine Gases and Explosions" gives 1 to 9.57 as the maximum explosive mixture. If we take the specific gravity of methane as 0.559, we have

$$0.559 : 9.37 :: 1 : X, \text{ therefore } X = 17.12,$$

or 1 part by weight of marsh gas to 17.12 parts of air.

It has been figured that 1.359 lb. of coal containing 20 per cent. volatile matter, will replace 1 lb. of marsh gas; we thus have

$$1.359 : 17.12 :: 1 : X, \text{ or } X = 12.59.$$

That is, 1 part by weight of coal of the composition stated, will require 12.59 parts of air. For present purposes, 1 part of coal to 13 of air is near enough.

If we take the specific gravity of bituminous coal as 1.2, the weight of a cubic foot of water as 1,000 oz., and the weight of this same volume of air as 1.2 oz., we have that the weight of a given volume of coal is 1,000 times that of an equal volume of air. As an amount of air 13 times the weight of the coal is necessary to maximum explosive force, we thus have 13,000 volumes of air required per volume of coal.

Standardization of Screens

The tendency seems to be to adopt the 200-mesh screen as the definition of dust proper. The standardization of screens has been discussed at intervals, for some years past; however, there appears to be difficulties, largely mechanical, in the way of the desired degree of exactness of the smaller sizes. As proposed by the committee in standardization of screens, appointed by the council of the Institution of Mining and Metallurgy, London, the aperture of the 200-mesh screen should be 0.0025 of an inch, corresponding to the 0.0002083 part of a foot. The radius of the sphere that would exactly fit this aperture would be 0.0001042. In order that the sphere should pass through the screen without clogging, a certain amount of clearance will be required. If we allow 0.0000042 for clearance, we thus have the 0.0001 part of a foot as the radius of the largest sized sphere that will pass through a 200-mesh screen.

If we denote the radius of the sphere by r, and the radius of the hollow spherical shell, surrounding the particle of dust, and having 13,000 times the volume of the sphere, by R, we have

$$\tfrac{4}{3}\,R^3 = 13{,}001 \times \tfrac{4}{3}\,r^3, \text{ or}$$

$$R = r\sqrt[3]{13{,}001} \quad \therefore\ R = 23.51\,r.$$

The radius of the hollow spherical shell of air surrounding the particle of coal dust, expressed in fractions of a foot, is thus 0.002351.

It need hardly be said that the relation of the radii would have been the same, had the sphere been one foot for instance, in diameter, but we are not discussing lump coal.

We have now reached the point where further exact progress is barred by the lack of exact information. We can only surmise the possibilities in the case.

It may be argued with good reason, that

*Mining engineer, Maybeury, West Va.

in the spherical shell of air, the radius of which is 23.5 times that of the particle of dust, it is a physical impossibility for all the atoms of oxygen to be in actual contact with the particle of coal dust. Quite probably this is correct, yet there appears to be at least a few words that can be said in favor of the opposite view.

If the atoms of oxygen and nitrogen were of the same relative sizes, and the same distance apart, as the molecules of coal, we would have approximately 13,000 of the former in the spherical shell surrounding our one particle of coal dust. Necessarily only a negligible proportion could be in actual contact with the coal.

As far as noticed, we have no definite information as to the relative sizes of the atoms of the different elements. It appears somewhat plausible that there is a considerable difference in the relative sizes of the atoms of oxygen in the air and the molecules of coal.

It seems not improbable that the molecules of water and the molecules of coal are at least approximately about the same size. In the same way, the atoms of oxygen, as liquefied oxygen, are possibly of somewhat the same size as the molecules of coal. It however requires about 320 atmospheric pressures to liquefy this gas. If the atoms of oxygen, when the gas is in the liquid state, are the same size as the molecules of coal, the atoms of oxygen in the gaseous state should occupy 320 times the space they do in the liquid form. They are not, however, necessarily 320 times as large. On this basis, there could be only about $\frac{1}{320}$ the number in the spherical shell that there would be, if the atoms of oxygen occupied only the same space as the molecule of coal. This would equal 40 atoms of oxygen and nitrogen per molecule of coal.

We, however, get a somewhat different figure by another method. Suppose instead of a sphere of coal 0.0002 ft. in diameter, the coal has been reduced in size until we have a single isolated molecule of coal. The relative proportions of the radii, and the relative volumes, will remain the same.

Under Certain Conditions, Coal Dust, as such, can Explode.

According to our formula for coal containing 20 per cent. volatile matter, we have that a molecule of coal contains 11 atoms of carbon and hydrogen together with 80 atoms of oxygen and nitrogen. If, however, we assume that the oxygen and nitrogen in the atmosphere exist in a sort of a double state, as molecules consisting of 2 atoms each, we have 40 molecules of oxygen and nitrogen, as before.

If we have only 80 atoms in our spherical shell, the contents of which is 13,000 times that of the molecule of coal, it seems reasonable to suppose that they must be in a state of intense vibration, while also having a range of motion many times greater than their actual diameters. If such a state of affairs actually exists, it is not unreasonable to suppose that every atom of oxygen and nitrogen actually touches the molecule of coal, not necessarily at the same moment, but in such rapid succession that the intervals between are so close together as to be far past our comprehension. For all practical purposes, all the atoms of oxygen would be at all times in immediate contact with the molecule of coal. Under these circumstances, no reason is evident why coal dust, as such, cannot explode, depending, however, somewhat on the size.

If now we replace our single molecule of coal by a particle of dust containing 5 molecules, we have, on the assumed basis, 200 molecules of oxygen and nitrogen in the surrounding spherical shell. In this case, it is still possible that all the molecules of oxygen come into actual contact with the particle of dust, although the interval between the time any one molecule of oxygen comes in contact with the particle of dust, and the time of its next contact, is probably much greater.

If this process be continued until we have 13,000 molecules of oxygen and nitrogen in the spherical shell, we have, in one way, reached the same state of affairs as if the molecules of oxygen and nitrogen had occupied the same space as the molecule of coal. One point of difference however is, we should have a particle of coal dust containing approximately 320 molecules of coal, and in the other case, only a single molecule.

If it be thought plausible that a single molecule of coal can result in an explosion, whether the explosion result from the molecule as a whole, or from its component parts, it seems that one point has been made. It has long been conceded that dust becomes dangerous in proportion to its state of subdivision. The foregoing theory is a possible explanation of the observed fact.

All that has been said may, however, be absolutely disregarded, without seriously impairing the case of the prosecution against the supposed deduction, on the score of relative volumes, that an explosion of coal dust is an impossibility. It is possible that no such deduction has been intended. This may altogether be a mistake, although if it is not, the line of argument on the score of relative volumes appears seriously defective in one important respect.

This may be illustrated in the case of our particle of coal dust containing 320 molecules of the carbon compound usually known as coal, by introducing within the spherical shell containing 13,000 molecules of oxygen and nitrogen, 300 additional particles of coal dust, preferably of the one molecule size, in order to prevent crowding out too many of the molecules of oxygen and nitrogen. We thus have a large excess of dust, it is true, over and above that required from a chemical standpoint, yet as far as the molecules of oxygen being in practically direct contact with the particles of dust, it appears at least plausible that we have much the same situation as with the one molecule particle of dust in a spherical shell containing 40 molecules of oxygen and nitrogen.

In other words the interesting relation of the relative volumes of coal and air, necessary to produce an explosion, appear to prove, not that an explosion is an impossibility, but that a large excess of dust is required, depending, however, upon the sizes of the particles of dust, measured in molecules, as well as upon the absence of such internal motion as results from a blown-out shot.

Distillation of Volatile Hydrocarbons During an Explosion.

Bituminous coal certainly gives off volatile hydrocarbons at a temperature below which the coal actually begins to burn. In the case of dust, which is in the act of exploding, if the fixed carbon did not take part in the reaction, the distinction that dust as such, does not explode, would have practical significance.

As far as we know, however, it is not at all clear that the fixed carbon should not, or probably does not, take part in the reaction. If the temperature of the dust, and of the air in which it is suspended, is sufficiently high to distill the volatile hydrocarbons, previous to the actual ignition, certainly the combustion of the hydrocarbons thus distilled will raise the temperature of the air, and the resulting coke, to a temperature far above that necessary for the combustion of the latter substance. It is hardly supposed that there is any question that the initial temperature may be that found underground, and yet the combustion of the distilled hydrocarbons be sufficient to raise the fixed carbon to the point of ignition. If coke is deposited in quantities, as it often is, it seems more plausible to assume that the supply of oxygen was insufficient for the combustion of all the dust. That such hydrocarbons as were volatilized but not consumed, owing to lack of air, remained in suspension, while that portion of the fixed carbon not consumed from the same cause, was deposited, owing to its greater specific gravity.

If the fixed carbon does not take part in the reaction, we would thus have two varietiies of gas explosion. Even in this case, it would be appropriate to retain the name, dust explosion, as applied to that variety of gas explosion in which the hydrocarbons were distilled from coal dust suspended in air.

If the fixed carbon does take part in

the reaction, it would comply more nearly with the facts to describe it as a gas and coke explosion, although clearly, in this case, an explosion which has resulted from dust suspended in air.

Excess of Air and Water Theory

It has been estimated that the total number of deaths resulting from explosions is 5 per cent. or less, of the total number of fatalities, while we have it on good authority that the deaths resulting from falls of roof is 66 per cent. of the total. It appears to have been assumed that the 66 per cent. is due entirely to the slacking or disintegration of the roof by moisture, during the wet or summer season. As far as noticed we lack the data to mathematically demonstrate this view to be incorrect.

For the past 15 or 20 years it has been the general belief among old miners that it is advisable to pay the closest possible attention to the roof, as soon as the drops of moisture begin to appear in the spring. The time has been when these evidences of the approaching wet season, which make their first appearance at the drift mouth, were looked upon with no little fear and trembling. These sensations became a thing of the past, and were replaced by the growing conviction that there are no substantial grounds for the common belief of the miner that the summer season results in a material increase in the number of falls of roof.

That a large proportion of the slates which form the roof in many of our mines disintegrate rapidly on exposure to the air, on the slate dumps, cannot be denied; However, it is not clear but that the distintegration is evidence of the inherent weakness of the slate, the lack of cohesion of the latter being the true cause of the fall, and the disintegration being merely an indication of lack of strength.

It has been estimated that the proportion of slate or fireclay roofs in West Virginia, will average 90 per cent. or better. This appears somewhat high, if the territory adjacent to the Norfolk & Western Railway may be taken as an average for the State. This, however, is again one of the numerous points in regard to which it is only possible to give an opinion. The percentage will depend no little on the classification.

For present purposes, it appears justifiable to class as sandstones, all thin-bedded sandstones, or sandy slates. These latter usually form nearly as good roof as true sandstones. The slates, so-called, have been looked upon as more properly shales than true slates. Under this classification, for the territory stated, 50 per cent: sandstones, and 50 per cent. shales appears a probable figure. If, however, 40 per cent. sandstones and 60 per cent. shales, be taken, we have of the 66 per cent. mortalities, about 40 per cent. occurring under slate or shale roof, and 26 per cent. under sandstone.

Many Fatalities from Robbing Pillars

Anyone who has spent much time on pillar work cannot but admit that about one-half of the fatal accidents occur in their recovery. Certainly the falls of roof on the pillars cannot be attributed to the effect of too high a percentage of moisture in the air. On this basis, we have 20 per cent. of the total number of fatalities that occur under shale roof, in other portions of the mines than the pillars.

Certainly "draw slate" is the cause of a large number of deaths each year. Draw slate, although a somewhat indefinite term, may be said to occur more generally in mines with sandstone roofs. Under this head is often included a layer of shale immediately overlying the coal, but less firm in structure than the shale next above, and from which it is usually separated by a parting plane. Even the novice in the business knows that the dreaded draw slate does not wait for the wet season. The number of cuts that the draw slate will stand, after the coal has been removed, can usually be counted on the fingers of one hand, although in a few sections or districts, if well timbered, it will stand for years. While most of the fatalities due to draw slate are properly chargeable to sandstone roof, certainly a small percentage at least should be charged to slate or shale roof.

We have still to account for the treacherous kettle bottom, which knows no law, and is no respector of persons. Kettle bottoms and horse-backs occur in slate roof rather than sandstone. If we allow only 5 per cent., which appears rather an underestimate, for draw slate under shale roof, and for horse-backs and kettle bottoms under the same class of roof, we have but 15 per cent. unaccounted for.

If this 15 per cent. is due to the causes under consideration, excess of air and water, it is at least a possible view that the general effect should be that the roof would scale off in thin layers, as that immediately exposed to the action of the agencies under discussion, had become disintegrated, thus exposing a fresh surface. Certainly the appearance of a large proportion of the falls does not indicate any such action. Again we have a small proportion of coal top, upon which air and water appear to have no effect. If we deduct 5 per cent. for falls of coal top, and for falls in mines in which the top comes down in somewhat rectangular blocks, we thus have but 10 per cent., which may be charged to excess of air and moisture, although there are still other minor classes of accident that might be deducted.

These figures will probably be considered grossly incorrect by some, possibly by many; yet whether the per cent. be 10 or 66, it appears largely at least, chargeable to inherent weakness of our shales, in the territory mentioned. As far as it has been possible to judge from prospecting in advance of actual mining, as shown by nearly 1000 sections of record in Wyoming, Logan, Boone and Wayne counties, W. Va., Pike and Johnson counties in Kentucky, and a portion of Buchanan county, Va., the roof has appeared to average much the same as in the territory adjacent to the Norfolk & Western Railway, in which mining is being carried on, in Mercer, McDowell and Mingo counties.

It is by no means contended that strata immediately overlying the coal are not in instances, seriously affected by water. Such is understood to be the case in some of the mines in the anthracite field of Pennsylvania. A roof that appears to be so affected has been noticed in the vicinity of Middlesborough, Ky., however the impression is that these are the exception and not the rule.

If the 66 per cent. of deaths was due to the excess of water alone, we would have this situation: From the 34 per cent. due to other causes 5 per cent. due to explosions would have to be deducted, leaving 29 per cent. equally distributed throughout the year, or 15 per cent. in winter during the dry season, the remaining 14 per cent. occurring during the wet season, which with the 66 per cent. due to moisture, would make 80 per cent. during the summer and 15 per cent. during the winter, exclusive of explosions. Any such increase confined entirely to one season, could hardly have passed unnoticed. That a difference in the volume of air passing can have any material effect of itself, other things being equal, appears less plausible than the excess of water theory.

The distintegration on the outside is more likely due to the daily changes of temperature than to exposure to the air, which would occur in the mines were the fan not running.

It is realized that the several views herein expressed are only personal opinions, which may in part at least be seriously incorrect. Yet if mining men and engineers would aid, with their ideas and experiences, we should in time make material progress in the control of dust.

In hydraulic mining in Victoria, Australia, gravel is being elevated to great hights. At the Creswick Black Lead the tailings are being raised to a hight of 102 ft. by a three-port runner pump in one lift, the depth of gravel worked being 70 ft. At the Cock's Pioneer mine, where a 80-ft. bank of gravel is being worked, the tailings are being raised to a hight of 123 ft. in two lifts.

Utilizing Blast Furnace Gases at Gary

A Great Power Plant to Be Operated by Gases Which Were Formerly Considered Waste and Allowed to Escape. Gas Engine Development

SPECIAL CORRESPONDENCE

Frequent references have been made in the columns of the JOURNAL to the utilization of blast-furnace gases in furnishing power. In this development in iron making German and Belgian metallurgists have been far ahead of those in the United States. The latter, however, have taken up this question with energy. The first important plant of this description installed in this country was at the works of the Lackawanna Steel Company at Buffalo. The metallurgists of the United States Steel Corporation some time ago began to study out the application of this economical development, and have used it in the alterations and improvements made at the various Carnegie works at and near Pittsburg, and the Illinois works at Chicago. The most important use of blast-furnace gases, however, is found at the new works of the Indiana Steel Company at Gary—a general description of which was given in the JOURNAL of Dec. 26—where the largest plant of the kind ever designed or built will shortly be in operation.

VOLUME OF GAS AVAILABLE

It is unnecessary here to go into the general subject of the utilization of the waste gases. As a general rule, only part of them have been used heretofore, in two ways: First, in heating the stoves through which air for blast is passed to raise its temperature; and second, to a small extent, in boiler furnaces for making steam. These uses are still continued, but the balance of the gases which in most blast furnaces is allowed to escape, are here used to generate power through the medium of the gas engine.

Speaking generally, a 500-ton coke furnace of the type built at Gary will pass off in 24 hours about 2,800,000 cu.ft. of gas. When all the 16 furnaces are in operation, this will give about 44,800,000 cu.ft. daily. Of this supply approximately 30 per cent. will be used for heating the blast stoves, 7.5 per cent. under boilers for raising steam, while 5 per cent. will be consumed for various auxiliaries, or lost in the cleansing process. This leaves 57.5 per cent. of the total to be used in generating power, of which 12.5 per cent. will be required for the blowing engines, leaving 45 per cent. of the total available to generate power for the operation of the works. This 45 per cent. will be equivalent, when all of the 16 furnaces are in blast, to over 200,000 horsepower.

CLEANSING THE GAS

The first step is to free the gases from the large quantity of dust carried over by them from the furnaces, and also to cleanse them from other impurities so far as possible, and to bring them into proper condition for use in the gas engines. The gas from each furnace, escaping from four outlets, passes into the two downcomer pipes, which lead into a reservoir 30 ft. in diameter by 40 ft. high, called the dry-dust catcher. Then a considerable part of the impurities settles to the bottom, and the gas passes into another large pipe, which leads upward some distance to increase the quantity of dust dropped and then turns down again, emptying into a supplementary tank 14 ft. in diameter by 25 ft. high, one of which serves each pair of furnaces. This structure not only provides an additional dust catcher, but also acts as a valve, being divided into two compartments partially filled with water. By increasing the hight of the water in either one, the furnace on that side can be cut off as desired, and there will be no back flow of gas from the mains beyond. The two chambers of this tank discharge into a pipe 10 ft. in diameter, which carries the gas and remaining impurities into the primary wet washers. There are three of those to each pair of furnaces and each has sufficient capacity to take care of the gas from a single furnace, thus providing a spare washer for use while one is being cleaned or repaired. The primary washers are cylindrical in form, with cone bottom and cone top, and are about one-third full of water, a proper overflow maintaining the required level. Here the gas and dust are discharged against the surface of the water from pipes with fluted edges and then escape around these edges into openings from a larger main. At this point a small percentage of the gas is diverted to special furnaces under a battery of Rust boilers used for making steam, and about 30 per cent. is taken for heating the stoves. The remainder continues on to the secondary washers. First of this group are the vertical scrubbers, drums about 14 ft. in diameter by 50 ft. high. A torrent of water cascades down through it, and from near the bottom of the drum comes the stream of gas against it. Rising to the top the gas again passes on into what are known as Thiessen washers, of which there are four to each pair of blast furnaces. In each of these it is led between the wall of a cylinder and a revolving drum, armed with a series of paddle-like blades. A stream of water is spread into a film on the surface of the cylinder and the whirling drum throws such impurities as the gas still holds out against the water film, where they are caught and held. From these final washers the gas is conveyed under slight pressure to the holders, each of which has 200,000 cu.ft. capacity; from there it goes, as required, to the electric-power station and blowing-engine houses. The water for the various processes described above is furnished by four large Platt turbine pumps.

THE BLOWING ENGINES

For the eight furnaces thus far erected there are two blowing-engine houses. One is 600 ft. long and 104 ft. wide, and the other is of the same width, but only 530 ft. long. The difference is due to the fact that the first house includes a central pumping and hydraulic power plant, equipped mainly by the Snow Steam Pump Works, of Buffalo, N. Y. Besides gas engines each house contains two steam-driven Tod blowers, but, when the plant is in full operation, these will not be used, but held in reserve in case of accident.

Each of the 16 blowing engines consists of a horizontal, twin-tandem gas engine of 2500 horsepower, having cylinders 42 in. diameter by 54 in. stroke, and two direct-driven blowing tubs having a capacity to deliver 30,000 cu.ft. of free air per minute against a pressure of 18 lb. per sq.in., and so designed and proportioned that they can be operated at any pressure up to 30 lb. These blowing tubs are of the Slick type, the patents for which are controlled by the Allis-Chalmers company. By using this type an inlet-valve area of 25 per cent. and over is easily attainable, thus insuring that the cylinder will fill completely at any speed at which the engine is able to operate it. The gas and air cylinders are located at opposite ends of the engine frame. Eight of these engines were built by the Westinghouse Machine Company and eight by the Allis-Chalmers Company.

THE GENERAL POWER STATION

The power station, which is 966 ft. long and 105 ft. wide, with forty-two 23-ft. bays, is adjacent to the blowing-engine houses and between the blast furnaces and open-hearth furnaces. This places it advantageously for fuel supply and insures minimum lengths of transmission lines to the various departments using electric power.

In this central station are installed 17 horizontal, twin-tandem, double-acting gas engines, turning at a speed of 83⅓ revolutions per minute; 15 of which are designed

for coupling to alternating-current generators and two to be connected to direct-current generators. The former are 25-cycle, three-phase, 6600-volt machines, and the latter deliver current at a pressure of 250 volts. The engines have a rating of 4000 horsepower and the generators 2000 kw., but they are capable of carrying continuously 30 per cent. overload. The 17 units were built complete by the Allis-Chalmers Company. These are the largest engines in the world to operate on blast-furnace gas, being practically duplicates of the units built for the Illinois Steel Company, operated in parallel. The successful working of that plant insured the success of the Gary installation.

Features of the Engines

The distinctive features of the engines are the simplicity of design, the solidity of construction and the quiet operation. Maximum overloads are handled in practice as easily and with the same freedom from vibration that characterizes their operation under normal condition. While the engines are, as a whole, exceptionally rigid and heavy, the weight is concentrated in the frame cylinders and tie pieces in the direct line of stresses to which an engine of this type is subjected. In the frame is illustrated the principal difference between European and American design. This frame is designed for a side crank in place of the double-throw crank which represents the standard practice abroad. The stresses transmitted to the frame in a side-crank engine are very great, but, even in the largest sized gas engines, they are no greater than builders have for many years successfully provided for in steam-engine practice.

The jaw, which is subjected to peculiarly severe stress, is made in a form to insure maximum strength of the casting and is further strengthened by two steel tie bolts carried above the shaft, which are made of sufficient size to carry their proportion of the load without appreciable elongation. This construction eliminates entirely any bending stresses in the frame at this point. The engine frames weigh approximately 90 tons each, and one-half of each frame is buried in the foundation, in order to raise the floor line to a point which will make the rods on the valve gear readily accessible.

The floor space occupied by one engine is 70x44 ft., and the weight approximates 1,700,000 lb. The cylinders are 44 in. diameter by 54 in. stroke; the crank pins are 20 in. in diameter; the shaft is 30 in. in diameter in the bearing, and the flywheel is 23 ft. in diameter, weighing 200,000 lb. The pistons and rods are water-cooled, water being introduced at the center and flowing forward to a discharge in the frame for the front piston and backward to a discharge in the tail guide for the rear piston, each piston having its separate supply. For dismantling or for cleansing, the rod is made in two parts, joined at the central slide, the rear half going out at the back of the engine and the other half going out through the frame, which is made open at the top for convenience.

The Valve Gear and Other Details

The valve gear is located between the engines, concentrating on a twin-tandem in such a way as to make it very convenient for the operating engineer. The gear is of the builder's standard stratification type and the engine operates with constant compression, thus tending to insure smooth running under the highly variable loads to which it is subjected.

The igniters are electrically controlled and so arranged that the time of ignition may be regulated by a single hand wheel. Direct current at 80 volts is used in the ignition system. Duplicate independent igniters are provided at each end of the cylinder to insure prompt firing of low-heat gases and also to avoid the danger of shutdown due to short-circuit. The entire ignition system, from the motor generator set which furnishes the current to the electrically operated igniters, is solidly built.

The air-starting device consists of a small poppet inlet air valve at each end of each cylinder, operated by the layshaft. Air is admitted to each cylinder, in turn, at what would be the working stroke. As the high compression carried prevents the engine from stopping on the dead center, this arrangement insures the prompt starting of even a tandem engine without the use of a barring gear. These engines being twin tandem will, of course, start from any position.

All wearing surface, including the main bearings, slides, crank and crosshead pins, are arranged for a continuous oiling system and the cylinders are lubricated by carefully timed admission of the cylinder oil, sight-feed oil pumps being used.

The exhaust from the gas engines is conveyed to a tunnel 12x9 ft., located immediately outside the building and beneath the ground level. This runs the length of the building and is provided at each end with a stack 9 ft. in diameter by 92 ft. high. The same method of muffling the exhaust is provided for the blowing-engine houses.

The Generators

The alternating-current generators are of a type developed by the Allis-Chalmers Company for use with these engines. The laminated stator core is held in a heavy box yoke designed to allow full circulation of air around all parts. The core punchings are held in place by means of dovetails and the armature windings are placed in open slots in the inner periphery of the stator core. The coils are held firmly in place by wedges and, on account of the open-slot construction, can be readily replaced in case of damage. The field poles are mounted on a cast-iron spider and so arranged that they can be removed; the exciting coils are of copper strip wound on edge. The revolving fields are special in construction, with field poles of solid cast steel bolted to a heavy cast-iron spider; they can, therefore, be readily removed in case it is necessary to get at a field coil. The field windings are held in place partly by the projecting pole tips and partly by brass rings running completely around the rotor on each side and fastened to the top of the poles by long brass screws. The construction, combined with the solid poles, gives a large damping effect, prevents hunting and aids in securing parallel operation.

The direct-current generators have also been designed with particular regard to this service, but in general are similar to the Allis-Chalmers standard engine type machines.

In connection with the generators the company has furnished Cutler-Hammer remote-control field rheostats and field switches. The controlling apparatus is located in the basement as near as possible to the generators and is operated from the bench board located in the power-house gallery. These rheostats are of a unique design, being what the manufacturers call the crosshead type. They are driven by means of vertical motors and are provided with automatic devices which insure the stopping of the motor at either limit of the crosshead travel; that is to say, either when all resistance has been cut in or cut out of circuit. Means are provided, also, for operating these field rheostats by hand in case of damage to the motor.

The Electric Motor Drive for the Plant

The power generated will be distributed throughout the works and used to operate the heavy induction-motor-driven rolls, the tilting and feed tables for the various passes, the hot saws, hot and cold pull-ups, hot rolls, transfer tables, straightening and drilling machines, cold saws, elevators, conveyers, pumps and a multitude of machines and mechanical devices auxiliary to the operation of the rolling mills. Several of the motors built by the General Electric Company for these works are of 6000 h.p. each, being designed for driving the rolls, and from this they range in size down to machines of the smallest capacity used to operate switches in the power house.

The problems of control presented by the multitude of motors installed at this plant involve many interesting features, the solution of which was largely intrusted to the engineers of the Cutler-Hammer Manufacturing Company, of Milwaukee, and the automatic devices now installed at Gary represent the most recent developments in electric control as applied to steel mill machinery.

The electrical system as a whole is subject to central control at a switchboard operated from a gallery 16 ft. high. This switchboard, which was designed by the

Western Electric Company, has the usual complement of instruments of standard types.

Storage Battery

To aid in securing maximum economy under heavy fluctuations of load, by utilizing the full value of the generating power of the gas, without regard to the amount of current required at any given time for the operation of the mills, a storage battery installation furnished by the Electric Storage Battery Company, has been housed in a two-story building 87 ft. long by 47 ft. wide, located near the power station. The batteries will be kept charged as nearly as possible to their full capacity, in order to assist in meeting, for a considerable period of time if need be, any demands for excessive power made upon the gas-engine-driven generators. These can, in themselves, be heavily overloaded but the best power factor is, of course, to be secured at about their rated capacity. The battery also aids in maintaining, at light loads, a constant pull on the generating equipment. The control of the battery charge and discharge in respect to the 250 direct-current bus is effected by means of two motor-driven boosters which may be operated singly or in parallel.

The various motor generator sets, converter, etc., comprising this regulating system may be started and stopped from the bench board in the switching gallery by means of Cutler-Hammer remote-control starting apparatus and the fields of the various machines may be varied by means of remote-control field rheostats. One of these remote-control starters is notable for its size. It is used in connection with a motor generator set which is started from the direct-current end, and although the starting current is not abnormally high, the rheostat is designed to carry 10,000 amperes under maximum working load conditions. This is believed to be the largest ever made.

Construction of the Power House

The subfoundation of the power station, as well as of each blower house, is a solid mass of concrete underlying the entire structure on the level of lake Michigan, and having a depth of 5 ft. Above this are separate foundations for each of the generating and blowing units. The arches forming the roof of the power station have a clear span of 85 ft., providing head room at the dome of 73 ft. above floor level. The station is served by two 50-ton cranes.

General Considerations

While the utilization of blast-furnace gases for the production of power has well passed the experimental stage, its adoption on so large a scale as that indicated above shows a high degree of confidence. The same thing may be said of the wide use of electric power throughout the plant, especially in the operation of the large rolling mills. As was said in the previous article, the Gary plant possessed one great advantage, in that it has been built up entirely on a new foundation. There was no old plant to be considered, no alterations to be made, and everything could be designed absolutely in accordance with the latest practice. No other steel plant of the first order has been built in this country under quite the same conditions. Moreover, the designers apparently have not been limited by any considerations of first cost, but had a free hand in introducing any improvements which could be expected to reduce operating costs, and help to secure the maximum output of finished steel.

The Cullinan Diamond

Special Correspondence

References have been heretofore made to the Cullinan diamond, believed to be the largest ever found. This stone, which was found in the Premier mine, near Pretoria in the Transvaal, on Jan. 26, 1905, was described and illustrated in the Journal of March 23, 1905. It was too large to be sold to any individual purchaser.

Over two columns of the London *Times*, of Nov. 10 are devoted to a full description—the first authentic description published—of the history of this great diamond from the date of its discovery up to the completion of cutting and polishing. The diamond, as will be remembered, was presented to King Edward on his birthday Nov. 9, 1907, by the Transvaal government. Since its arrival in England the most elaborate precautions have been taken for its safety. In traveling to Amsterdam, where it was cut it was in the care of three guards and to avoid risks of shipwreck it was conveyed across the channel by the shortest route, the Calais Dover. Such elaborate precautions were not adopted in its infancy, so to speak, the stone having been forwarded to London from Johannesburg by ordinary registered letter post.

The cutting and polishing were carried out by the firm of Joseph Asscher & Co., of Amsterdam, who put up special machinery for the work. The stone was divided at first into two and subsequently into several pieces. The first cleaving of the stone was a delicate and risky operation. There are two processes for dividing diamonds, sawing and splitting. In splitting a steel knife is used to part the stone along its natural cleavage planes, and it is only along these planes, which are four in number and lie parallel to the faces of the octahedron, that the division can be effected. The diamond is held in cement at the end of a strong wooden stick. The operator holds the knife—a wedge-shaped piece of steel resembling a toilet comb in its general form and size—in a groove, which must first be cut by a diamond, with his left hand, while in his right hand he delivers a blow with a steel hammer.

In splitting the Cullinan diamond the knife broke at the first blow, but the second blow was successful. It is always possible that this operation may break the stone into pieces not calculated on, owing to some flaw in the stone. There was therefore, much anxiety about the operation on this large stone. After splitting, the largest piece was cut and polished. The second piece was again divided and altogether a large number of brilliants were obtained. The following is a complete list of the stones with their weights:

1. A pendeloque or drop-brilliant weighing 516½ carats. The extreme dimensions of this stone are 2.322 in. long and 1.791 in. broad.
2. A square brilliant weighing 309 3/16 carats; 1.771 in. long and 1.594 in. broad.
3. A pendeloque weighing 92 carats.
4. A square brilliant weighing 62 carats.
5. A heart-shaped brilliant weighing 18⅜ carats.
6. A marquise brilliant weighing 11¼ carats.
7. A marquise brilliant weighing 8 9/16 carats.
9. A pendeloque brilliant weighing 4 9/32 carats.
10. Ninety-six brilliants weighing 7⅜ carats.
11. A quantity of unpolished "ends" weighing 9 carats.

The two larger stones are by far the largest in existence. The next in size is the Jubilee, weighing 239 carats, belonging to Wernher, Beit & Co. The famous Kohinoor weighs only 106 1/16 carats. All the Cullinan stones are, in spite of their size, of great beauty, being absolutely without flaw and of the finest blue-white color.

The two larger stones are cut with 74 and 66 facets respectively; an innovation on the usual practice of cutting 58 facets.

Transvaal Gold Mines

Gold production in the Transvaal in November is reported by the Chamber of Mines at 614,371 oz. fine, which is 3373 oz. less than in October, but 64,570 oz. more than in November, 1907. The decrease from October was entirely due to the shorter month, the daily average having increased from 19,818 oz. in October to 20,479 in November, a gain of 661 oz. For the 11 months ended Nov. 30 the total output was 6,393,974 oz. fine gold, or $132,163,443. This is an increase of 425,836 oz. over last year.

The total number of Kafir laborers at work in the mines Nov. 30 was 141,326, an increase of 2161 over Oct. 31. The number of Chinese was 12,293, a decrease of 19 only during the month.

Examining and Fitting up a Hydraulic Mine—II

The Construction of Sluices, Undercurrents, Grizzlies, Flumes and Penstocks, and the Building of Ditches Are Discussed in Detail

BY H. A. BRIGHAM*

The details of the design of a sluice are shown in Fig. 1. For the bottom of the sluice 1½-in. boards will answer and for the sides 1¼-in. The bottom planks should be surfaced on the top, the side planks should be left in the rough. The sills may be 4x5 in. for sluices up to 5 ft. wide, and 4x6 in. for wider sluices. The posts or standards are suitable if made from 4x4-in., and the post braces from 1½x4-in. timber. The bottom ties must be firmly laid so that no settlement will occur if the sluice should become filled with gravel. All joints in the bottom should close perfectly so as to prevent leakage of quicksilver and consequent loss of fine gold.

If there are springs along the line of the sluice, their water should not be allowed to back up and run over the top, since the pressure may force up the bottom, especially while cleaning up. Cutting a vent hole near the end of the side board, ½ in. above the bottom board, with the bottom side of the hole sloped upward toward the outside of the sluice to prevent the quicksilver from running out, will overcome this difficulty. Several of these holes should be made along the sluice, especially where there is danger of water backing up on the outside.

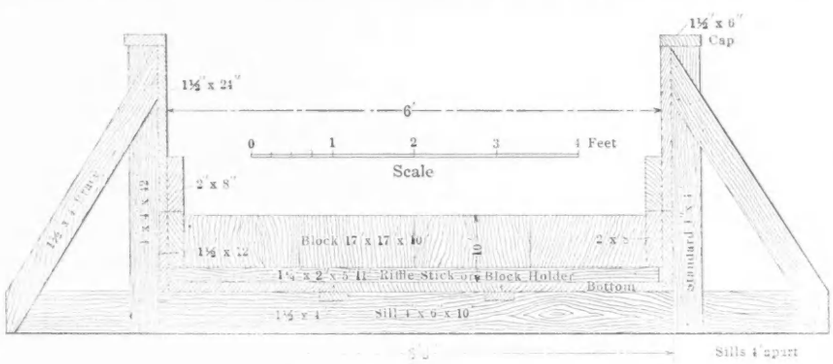


FIG. 1. END VIEW OF SLUICE

A longitudinal cap or running board, say 1½x6 in., should be placed on the top of the sides and nailed flush with the inner edge of the side board to prevent this from bulging into the sluice. The sides should be well braced against inward or outward bending. The sluice must be anchored down so that water outside will not lift it bodily.

Pavement

If suitable timber may be obtained at reasonable prices, a block pavement is generally the most desirable, especially for the upper end of the sluice where the principal portion of the gold particles will settle, and where the pavement will have to be removed more frequently for this reason. If the sluice must be longer than is necessary for the simple saving of the gold, it may be desirable to pave the lower portion with other material, if a suitable kind is obtainable at reasonable cost.

Rocks or boulders make a lasting pavement and, under favorable conditions, may be desirable if they are very hard and of such shape that they may be securely held in place, particularly if they do not present too uneven a surface for the gravel and boulders to travel over. Rocks blasted by dynamite are not suitable for pavement, owing to the shattering effects of the dynamite.

It will be almost impossible to pave a sluice with stones and to make a surface so smooth and even that the same amount of gravel and boulders can be run over it that will run over a block pavement on the same grade; therefore the portion paved with rock should have a proportionate increase of grade. This is of great importance as the volume of gravel and boulders that can be run through the sluice depends upon the amount that can pass its section of least transportability; that is, that particular portion which has the least grade or the most uneven surface.

If hard rock is used in the pavement it will probably wear at least five times as long as any block pavement before requiring to be changed by reason of uneven wear.

Steel bars and old railway iron make a very good pavement, for as much fine material and more boulders can be run over them than over a block surface. This iron pavement is generally more expensive, especially if the mine is situated at a great distance from a railway and lacks cheap transportation facilities. But it has the advantage of wearing much longer than blocks, and it needs less changing in consequence, an operation that always constitutes one of the largest expenditures and delays in hydraulic mining, especially where there are block pavements in long sluices.

Block Pavement

Blocks for pavement are generally made by sawing them from the trees in lengths suitable for the purpose for which they are to be used, say from 4 in. long, where a small head of water is to be used, to 12 in., or even more, where a large volume of water is run. These blocks are squared to such a size that a given number will reach across and just fill the sluice from side lining to side lining. Several different sizes may be used for the same sluice, but each size should be square, so that when replacing the pavement the blocks may be turned around in any manner best suited to make the smoothest surface possible.

It is very essential that the blocks be hewn squarely and truly and placed so tightly together that no crevice is left parallel with the current, for a small crack, more particularly if two or more are in line, will soon become larger by wear and will compel a cleaning-up and a change of the block system sooner than if this had been properly laid the first time; the wear, in that case, will be so irregular that it will be found most difficult to relay a satisfactory and smooth surface again without eliminating the uneven blocks.

Side Lining

The side lining of the sluice, shown in Fig. 2 as two 2x8-in. planks on each side, has two purposes—to protect the permanent side of the sluice from being worn, and to hold the blocks and prevent them from rising and floating away. The thickness of the side lining will depend

NOTE—Abstract of a paper read before the Technical Society of the Pacific Coast, and published in the *Journal* of the Association of Engineering Societies, October, 1908.

*Mining engineer, 1414 Filbert street, Oakland, California.

upon the width of the sluice and the quantity of water used.

With a narrow sluice and a small head of water, 1-in. lining will answer, while with a wide sluice and large volume of water, 2- to 3-in. lining is required, and this should reach sufficiently above the blocks to prevent the wear of the permanent side planking.

Boards are generally used for this purpose, but where there is a large amount of wear, blocks are sometimes utilized, especially if the sluice is located in a tunnel or at other places where it is inconvenient to change the lining. These blocks are made somewhat similar to block pavement by sawing them in 2½ to 3-in. lengths from the tree, dressed to uniform sizes for top and bottom, and of any convenient length for the sluice. They are nailed to the side similarly to board lining.

Riffle Strips or Block Holders

The riffle strips or sticks answer two purposes also: To hold the blocks in place and prevent their floatage, and to create the intervening space, crosswise in the sluice, between two series of blocks, known as the riffle, whose office it is to hold the quicksilver and to catch and retain the gold particles.

The dimensions of the sticks vary under different conditions and according to differing opinions of miners. They must be strong enough to prevent the blocks from lifting and broad enough to furnish a receptacle between the blocks ample in size to catch the gold. The thicker or broader they are, that is, the wider the space beween the blocks, the greater and the more uneven will be the wear on the block edges, and, consequently, the rougher will be the surface of such a pavement after the blocks have been turned and changed around.

If large boulders, especially angular ones, be run over a pavement, it will become manifest that the wider the riffle, the more will the lower edge of the blocks be broomed and split off; this will make a very rough surface upon turning.

If the riffle pieces are too high, the receptacle for the gold will become shallow and sometimes obliterated when the pavement is worn thin. A 1¼x2-in. riffle strip is sufficiently strong for a sluice 5 ft. wide; a wider sluice requires a 1¼x3-in. strip.

Laying a Block Pavement

A good method in laying a block pavement is to nail the side lining against the permanent side of the sluice, leaving the lower edge 2¼ in. above the bottom, where a 2-in. riffle strip is to be used; this will allow the end of the riffle strip to be inserted under it freely for the purpose of preventing the strip from lifting with the blocks when the water is turned on.

After the side lining is properly secured to the permanent side of the sluice, a row of blocks, all of the same size, is placed across it and wedged tightly together and against one of the side linings; thereupon a riffle stick is slipped under the side lining and pushed against the side of the blocks, raised up tightly against the bottom of the lining and nailed to each block with headless or small-headed nails, leaving ⅝ in. of the nail projecting for insertion into the next row of blocks.

After one row is properly secured in the manner described, another row of blocks is placed across the sluices, the blocks are pried close together and set up tight against the side lining that was not wedged to in the case of the preceding row, thus breaking joints in the blocking system. The blocks are thereupon driven solidly on to the nails and against the riffle stick. Another riffle stick is inserted after this, and the process is repeated in the same manner as just described and continued in both directions, up and down the sluice, provided there is no running water in it to interfere with the laying up stream.

After the entire sluice is properly paved and everything is in readiness for the water to be turned on, washing should be commenced with a small head of water, but when all the spaces are solidly filled with sand and fine gravel the full head of water can be used. In beginning to wash through a new sluice, where the ground on the outside is higher than the top of the pavement, caution must be used that the water does not collect on the outside to a greater hight than on the inside, unless the sluice has already been properly

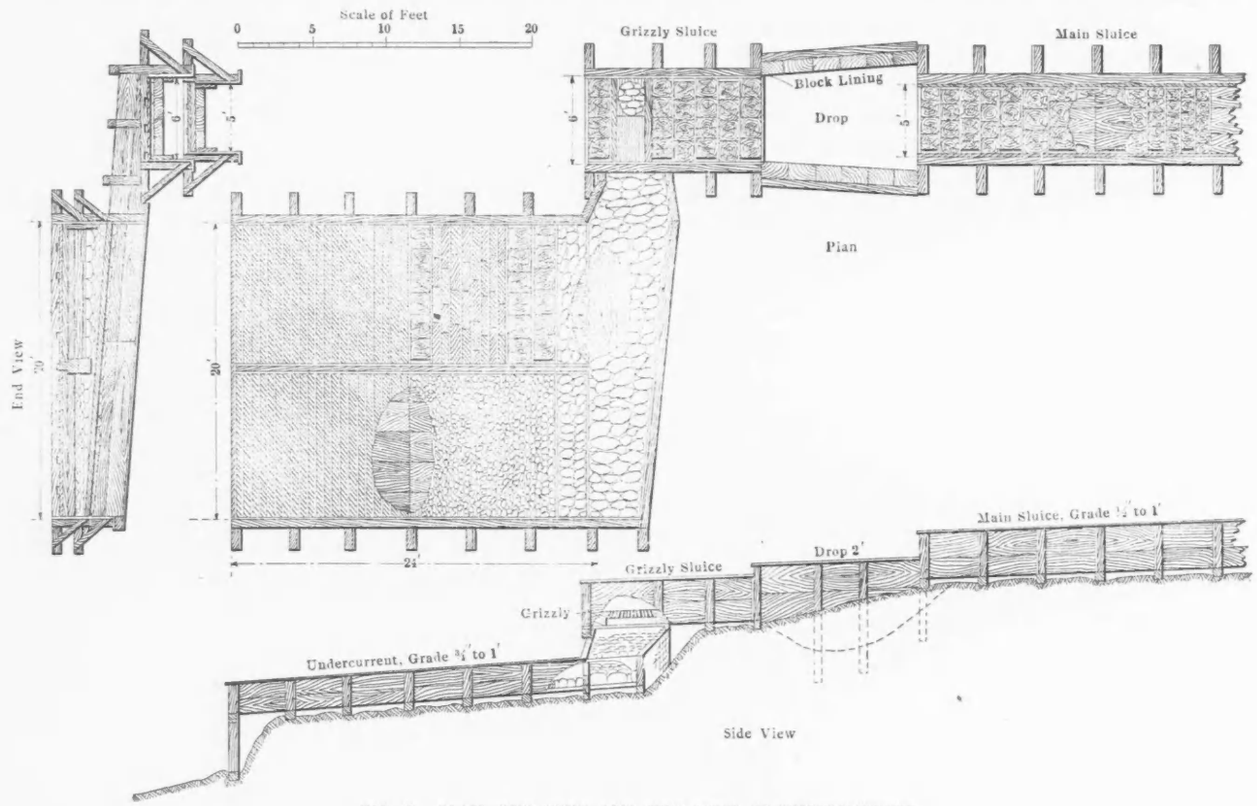


FIG. 2. PLAN, END VIEW AND SIDE VIEW OF UNDERCURRENT

anchored or weighted down. Unless it has been filled solidly with rock or dirt to the top exteriorly, it should at once be made to overflow until the outside is filled completely with dirt, even with the top, if possible; if this is properly done, there is no further danger of the sluice's being lifted.

If the channel or face of the gravel deposit to be worked is too wide to be washed through a single sluice or cut, one or more branches in the sluice are necessary. These should start near the head of the main sluice.

The distance between these branch cuts or auxiliary sluices will depend upon the character of the gravel deposit; in the case of a deposit containing much hard clay to be broken up, or large quantities of boulders to be conveyed, these branches should be nearer together than in a case where the deposit is composed entirely of fine gravel and sand.

If the deposit contains adhesive clay, especially near its bottom, so that it cannot be worked separately and apart from the pay-gravel, then the branches should be close to each other and placed at such a steep grade that they will keep themselves entirely clear, allowing nothing to collect therein while washing this pay-gravel; or, what may be still better, the sluices should be built up as closely to the bank as possible, to secure the gold quickly from the clay, for the reason that the sticky clay has a decided tendency to take up all the gold that it may come in contact with, and it will carry all this, or nearly all that it has once picked up, entirely through the sluice and away from the undercurrents at a total loss to the mine. Where the deposit is very deep and extensive it may be advisable to hydraulic it off in two or more successive benches, as this will give a steeper grade for working the upper levels.

Speaking generally, a bank 250 to 300 ft. thick is as high as can be conveniently hydraulicked in one bench, although, under favorable conditions, it may be practicable to work with safety from a single bench a bank that exceeds 300 ft. in hight. These conditions are: A large pressure for the giants; compact gravel, that will not run to any great distance from the bank when falling from the top in slides or avalanches, jeopardizing the safety of the giants; and also a wide open and roomy pit.

Cleaning Up

Cleaning up consists in removing the pavement, collecting and separating the gold from the sand and from the material lodged in the riffles or interstices of the sluice pavement. A clean-up is resorted to whenever it is deemed necessary to collect the yield of the mine. A clean-up is always required whenever the pavement is so worn by gutters that its surface becomes so uneven that it cannot be relaid to a sufficiently smooth surface without the use of additional paving material.

While the pavement is being removed during a clean-up the flow of water is reduced to a very small quantity. The work is commenced at the upper end of the section to be cleaned up. As the pavement is removed, the fine material will be washed down slowly along the bared bottom of the sluice, leaving in its wake the separated gold, which is taken up in pans by scoops made for this purpose. The process is finished by panning the remaining sand from the gold, or amalgam, if quicksilver is used.

Undercurrents

Undercurrents should be placed wherever the hydraulic miner may deem them most effective. An ideal location for an undercurrent is created by placing a section of sluice 12 to 20 ft. long, and 1 ft. wider than the main sluice, at an elevation 2 ft. lower and about 10 ft. distant from the end of it. Near the lower end of this wide section of sluice, and at right angles across it, a set of steel bars, called grizzlies by the hydraulic miner, is laid. (Figs. 2 and 3.)

To prevent choking, these bars must be so placed that the space between them is wider at the bottom than at the top. Ordinary bars, 1x4 in., can be laid with a little care in this manner; from 10 to 20 of these, spaced from 1 to 2 in. apart are used according to the character of the gravel and the volume of water used in the main sluice. Steel bars, made for the purpose, with one edge thicker than the other, make good grizzlies. The construction and location of these details are shown in Figs. 1 and 3.

Directly under these grizzlies, and parallel to them, a box from 2 to 4 ft. wide is provided, for the purpose of leading the water and fine material that has passed down between the grizzly bars into the undercurrent proper. The undercurrent should be from three to five times as wide as the main sluice, 24 to 36 ft. long, and should have about 50 per cent. more grade than the main sluice.

The number of grizzly bars, their distance apart, and the width and grade of the undercurrent will depend upon the amount of water used in the main sluice and the character of the gravel washed; the larger the head of water and the finer the material, the greater the number of bars, and the narrower the space between them; also, the wider the undercurrent, the steeper the gradient. Where there is a very large amount of fine material, the undercurrent should have still greater width and grade than under ordinarily normal conditions. All the fine material, with sufficient water to run it over the undercurrent, must be allowed to pass through the grizzlies.

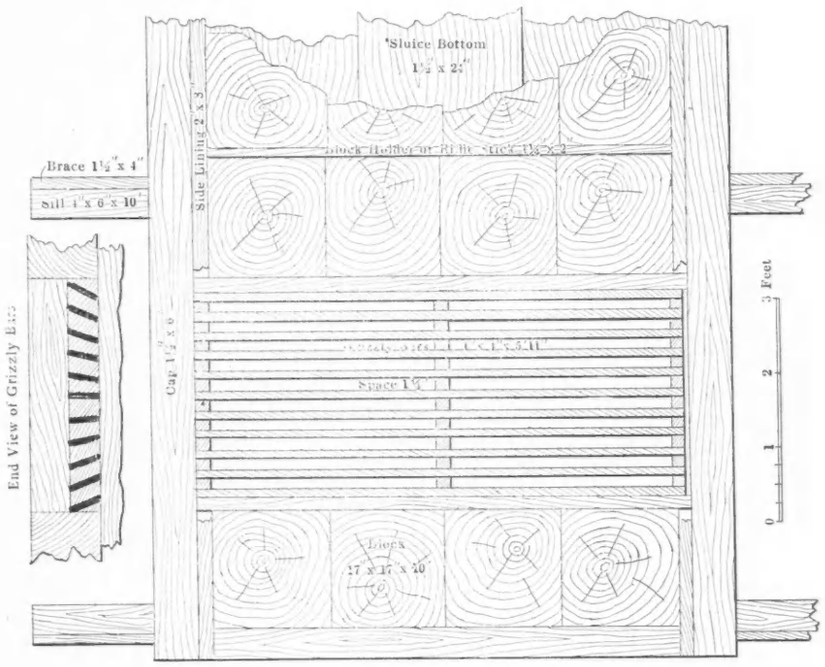


FIG. 3. PLAN AND END VIEW OF SLUICE

The purpose of the 2-ft. drop in grade below the main sluice is to reduce the current while passing over the bars; this will allow the fine gold to settle more readily and pass through between them, and it will also increase the life of the bars and make them last much longer than if they were placed at the end of the main sluice.

A good pavement or riffle floor for an undercurrent may be made of strips 4

in. wide and from 1½ in. to 4 in. thick, lined on top with ¼-in. steel plates held by countersunk nails. These riffles should be laid on edge, spaced 1¼ or 1½ in. apart; they may be laid either crosswise or longitudinally. Blocks also make a very good pavement.

If the richer portion of the gravel should be very hard or cemented, it is advisable to add more undercurrents if conditions will permit. To break up the cement, a high perpendicular drop is excellent. If on account of the filling of the dump with tailings that finally back up into it or some other cause, it becomes necessary to extend the main sluice from its lower end, the policy of placing an undercurrent at the lower end may be questionable; still it is impossible to operate one midway in a sluice without sacrificing at least 5 ft. of the grade in order to get the water and the fine material that passes over the undercurrent back into the main sluice again.

Water Storage.

The necessity of receiving or distributing reservoirs has been referred to before. They furnish facilities for regulating the head of water for the giants, and, in case it becomes necessary to turn off the water at the mine, they furnish an immediate supply of water when hydraulicking begins again. The capacity of these reservoirs must be determined by the daily quantity to be used by the mine; this again depends on so many other contingencies that one must consider them all before deciding upon the practical amount of storage. The details of construction are matters of engineering that must be dealt with as they come up.

Pressure Box or Penstock

A pressure box should be built at the head of the mine pipe-line. Fig. 4 shows a structure of this kind in plan and side and end views. It is more or less of a settling basin and strainer, intended to prevent sand and solids and also air from entering the pipe. A screen is provided to catch sticks, limbs and other floating débris too large to pass through the nozzles, while a sand box of ample proportions holds the sand and other heavy material and prevents that from getting into the pipe.

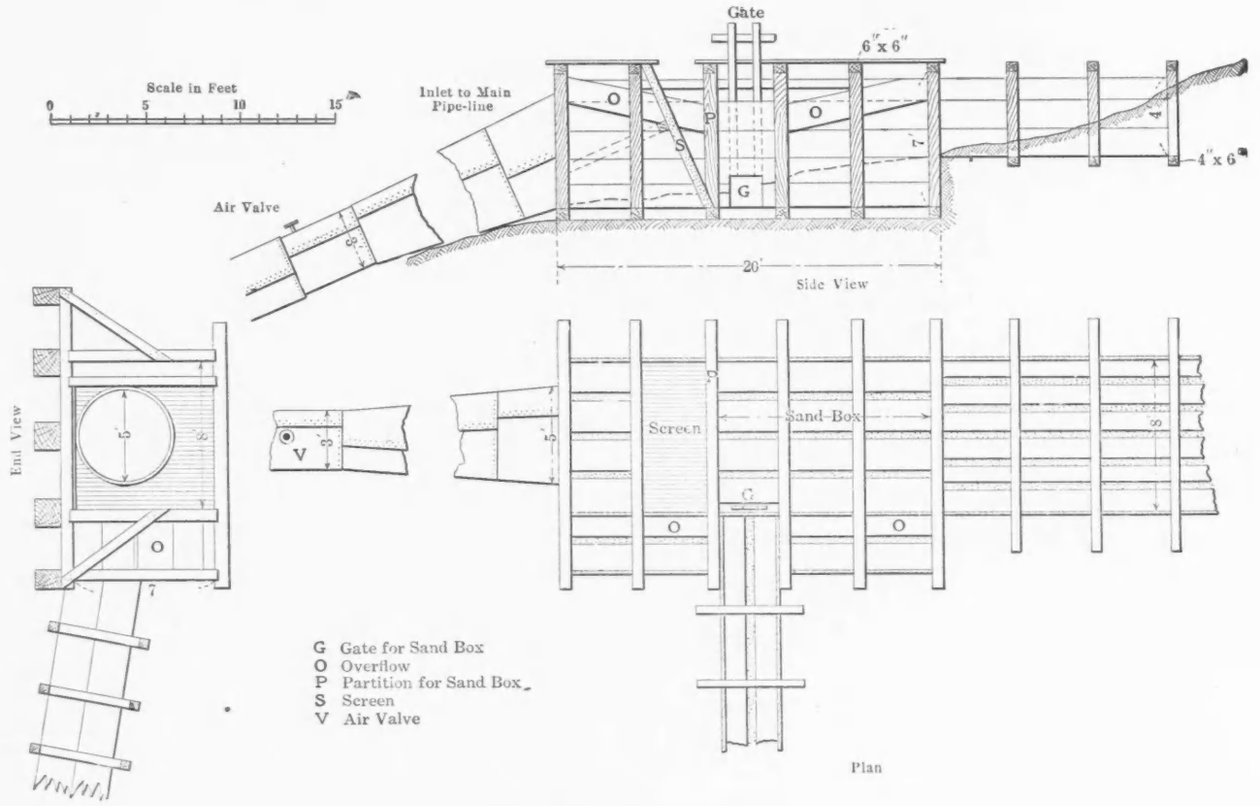


FIG. 4. DETAILS OF PRESSURE BOX

A spillway *O* is arranged on one side of the pressure box to prevent any damage from the surplus water. This should be wide enough to take care of any possible surplus due to clogging of the screen or variation of the flow. If the water is taken out of the main ditch directly into the pressure box, and the ditch continues past it, a spillway is unnecessary.

The screen *S* should be fine enough to prevent anything from passing through it that may choke the nozzles, and should be so constructed that it can be readily cleared. It should also be strong enough to withstand the pressure in case it is fully choked with branches, leaves and other matter of this kind, for that is liable to occur during a windstorm.

The sand box should be amply large; it has a gate at the side to sluice out the sand and to turn the water out of the pipe whenever it may be necessary to dry it. If a larger head of water is used than can be accommodated by the sand gate, a waste-way must be provided near the bulkhead, so that the pipe may be dried quickly in case of accident, or in case there may be any necessity for changing the water suddenly.

Mine Pipe-line

Where it is possible to bring all the water to one point to suit the conditions of head and locality, and in such a manner that one line may be made available for all the giants, a single line of ample capacity to convey all the required water is to be preferred.

A suitable gore or taper should be provided at the head of the pipe-line, at the point of intake from the pressure box, and this should be of such dimensions that the water in entering the pipe is not retarded. The lower the grade at the upper portion of the pipe-line, the larger and the longer the gore that will be necessary. In any event, it should be of ample size not to create needless friction, which reduces the pressure at the giants.

The main pipe-line should, if possible,

be laid away from the ground to be washed, and preferably, also, on a downward grade for the entire distance; long stretches of slack grade should be avoided, if practicable. As the pipe approaches the vicinity where washing is to be done, suitable branches should be inserted where required until the end of the main line is reached; there a gore must be inserted, tapering to the size of the branches, or a fork provided for two branches. Each branch should have a gate or cutoff.

The branches and gates should be placed as near to the commencement of operations as practicable in order that the working area of the giants may be extended from time to time without the necessity of moving the branch pipes and gates, which is expensive and causes much delay.

If, on account of the width of the gravel, two or more giants are to be used at some distance from the main line and away from the vicinity of the other giants, it becomes advisable to make the branch of the same diameter as the main line—with a gate attached—and to extend this branch line to the neighborhood of the giants; this will eliminate much of the friction due to long reaches of the smaller branch pipes.

All turns, gates and gores should be substantially braced to withstand the pressure, and the whole line should be anchored at short intervals to prevent its creeping downhill by expansion and contraction due to changes of temperature. Air valves of liberal area should be placed wherever they are needed along the line of the pipe to prevent collapse from any sudden withdrawal of the water below. There should be one at every point where the grade increases materially, and one below each cutoff, if the pipe below it has considerable grade.

It is necessary to provide more than one pipe-line where the contour of the country will not permit a satisfactory site for a distributing reservoir, but where one at a lower altitude is available; or, where a part of the water supply must be brought in a lower ditch system, too low to give a satisfactory pressure and yet furnishing valuable water; or, where the deposit of gravel to be worked is so extended and isolated that a branch from the main line cannot well be utilized for it

In the case of two available pressures at different heads, the higher pressure system should be used for the greater part of the cutting and the lower one for regulating the flow to the sluices of the gravel taken from the softer strata, or from the material that has caved under the force of the higher pressure.

Giants

The number and size of the giants will be governed by the amount of water used, the width of the face of the gravel to be worked, the pressure of the water at the giants, and the character of the gravel to be piped. It is better to use as large giants as practicable, for much more can be accomplished with one large giant than by running the same amount of water through two; besides, this saves the pay of one man.

The giants should be set as near the bank as safety from the falling bank will permit. If more than one is to be utilized at one point, they must be placed so that they will command as much of the bank as possible, and be in such a position that two or more may work together advantageously in a combined attack toward one point.

Deflectors are indispensable for the larger sizes of giants. A deflector is comparable to a delicate steering apparatus; by its aid the stream may be guided from one direction toward another. They are of two kinds. One consists of a short flexible coupling, inserted between the nozzle and the end of the discharge pipe; the other is a short section of pipe, a little larger than the nozzle, attached loosely to its end and projecting over the stream. Both of these deflectors turn on a gimbaled joint, free to move in any direction; a lever is attached for moving the deflector.

A light pressure against the lever in any direction bends the stream slightly; this, in turn, moves the discharge pipe, which follows it, as it were, until the stream strikes the desired point. The pressure is thereupon released, and the unmolested stream becomes normal, retaining this direction until the deflector is moved again.

Derricks and Overhead Trolleys

If there are many large boulders that have to be broken up in order to run them through the sluice, and if the grade of the sluice is light and the dump room scarce, it may be advisable to use overhead trolleys or derricks for handling boulders, provided of course, that the conditions are favorable.

The derrick is an awkward and cumbersome thing to use around a hydraulic mine, especially if the bank is high and the pressure for the giants light, for it is necessary to have the derrick in the rear of the giants; this places it too far from its work, unless it has a very long mast and boom.

An overhead trolley is generally preferable, as this interferes little with the giants; and while its reach is restricted sidewise, it has unlimited range from the boulder dump in the rear to the face of the mine; also, it seldom needs shifting as the working of the mine progresses.

Where there are large numbers of boulders requiring blasting in order to dispose of them through the sluice, and where the dump room is restricted, and where the conditions are favorable for utilizing derricks or overhead trolleys, it will be found much cheaper to dispose of these boulders in this manner than to run them through the sluice and choke up the dump.

Hydraulic Elevators

Hydraulic elevators may be used to good advantage at times; indeed, in some cases the conditions are such that this is the only method by which hydraulic mining can be successfully carried on. In the case of valuable gravel deposits, free from quantities of large stones, pipe clay, stumps, etc., situated near or below the level of the surrounding country, which require removal by hand, if a large quantity of water under the required pressure is at hand, the hydraulic elevator becomes a necessity. The elevators are placed near the head of the main sluice and at a lower elevation, depending upon the hight necessary to raise the gravel.

A hydraulic elevator, so called, consists of a pipe of suitable dimensions to convey or lift the water and gravel from a pit (sunk below the bottom of the deposit to be worked) into the main sluice above. It is generally built at a small vertical angle; the top reaches into the main sluice, while to its bottom in the pit is attached the elevator throat. A nozzle, set in line with the center of the elevator pipe, and parallel to it, is placed a short distance below the throat; water from the main pipe-line escaping through this nozzle forces the gravel and water from the pit up into the head of the main sluice.

One or more giants may be utilized for washing the gravel from the mine into the elevator pit in a manner similar to ordinary hydraulic mining, but all stones, clay, stumps, etc., too large to pass through the throat of the elevator, must be removed before reaching the pit. The elevator must be run continuously while the mine is in operation, for the pit becomes flooded immediately, whenever the water is turned off from the elevator nozzle. Any boulders, stumps, etc, that will run through the sluice can be elevated by this process equally as well as the fine gravel.

A giant under heavy pressure, placed at the lower end of the main sluice, may be used to great advantage in stacking or elevating the tailings wherever the dump room is ample in area but deficient in grade.

This giant at the dump may be utilized at any time, whether the sluice be running or not, whenever there is a surplus of water, or whenever it may be turned off from the mine. By using either a hydraulic elevator or a giant at the dump a larger grade for the main sluice can be obtained.

If there should be a depression in the bedrock of the mine below the grade of the sluice, or if the sluice as it extends ahead into the mine should pass over

valuable deposits, this gravel can be elevated and forced up into the sluice in a manner similar to the elevation of the tailings at the dump. This, of course, should be done after the top gravel has been worked down to the sluice grade.

The depth from which gravel can be elevated by this process depends upon the giant pressure. With a pressure of 300 ft. there should be no difficulty in forcing it up from a depth of 15 ft. or more.

Ditches

The old hydraulic miner became an expert in the location and design of a ditch to convey the necessary water to meet his requirements. He was remarkably successful in overcoming difficulties of topography, and mechanical difficulties as well, and he usually overcame them without scientific instruments or scientific formulas, guided alone by his keen sense of the practical and by his ever-resourceful mind.

While the hydraulic miner knew by experience how to arrange the fall, the grade and the size of the ditch, the engineer now has recourse to the elaborate formulas that have been devised to help him. The Kutter formula and its modifications furnish engineers with the means to design ditches of proper capacity and gradient in any material. A few practical hints, however, by an old hydraulic miner will not be amiss.

In laying out the line of the ditch care should be taken to avoid any abrupt turn, unless this be absolutely unavoidable. In making a turn around a sharp point, the line should be carried into the hill somewhat, in order to insure a strong embankment. In turning around such points, it may be desirable to raise the grade for the top of the ditch to correspond to the hight of the permanent roadway along the ditch, thus leaving a solid embankment to the full hight of the roadway.

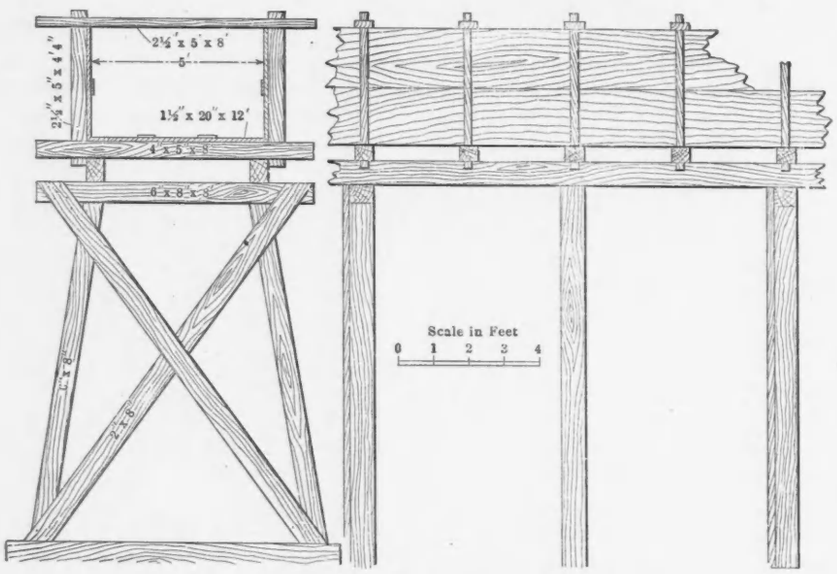


FIG. 5. DETAILS OF FLUME

Many of the old mining ditches bear testimony to his skill, to his perseverance and to his audacity. Mining and ditch building were almost synonymous terms in early days in California, and on the experience of the hydraulic miner much that we know today of the behavior of the flow of water in ditches and in pipes has been based. The investigations of Hamilton Smith are considered of great importance today, for Mr. Smith added no inconsiderable knowledge to what was at that time a rather barren field.

A ditch must convey the required quantity of water. To do so, it must have capacity and grade, or fall. These elements are interdependent and need to be placed in proper relation. The flow through a given cross-section of the ditch must be of a speed to permit the number of miner's inches to pass and yet not too swift to erode the material into which the ditch is cut.

The slope of the bank will be governed by the character of the ground along its course; the upper bank should be sloped back far enough so that the current cannot undermine it and cause slides or caves; accidents of this kind will occur during the rainy or flush-water season, if they occur at all, causing bad breaks, and entailing great expense, loss of water and delay while making repairs.

All trees liable to fall and damage the ditch ought to be cleared away. The surface below the ditch should be stripped of all brush, leaves, débris, etc., before commencing the excavation, in order that the material taken from the ditch and deposited on its lower bank may unite firmly with the undisturbed ground, making, after settlement, a solid and permanent bank; this will permit the miner to raise the water level in the ditch later on, thereby increasing the capacity considerably.

After the ditch is excavated the lower bank should be leveled down in such a manner as to leave a good roadway; this roadway should be considerably higher than the grade line so as to act as a protection against breaks, when, for any reason, small obstructions back the water slightly above the grade.

Flumes along the line of the ditch should be avoided as much as practicable, particularly if the water supply be partially or wholly cut off during the dry season; at such time the lumber will shrink and crack, damaging it more or less, and shortening its life considerably. Where conditions are favorable, a double wall may be built, filled between its two faces with clay or suitable dirt, by which a permanent bank is secured; and while this will increase the original cost, the extra expense may be justifiable.

Even in quite hard bedrock, it may be perfectly reasonable to do considerable blasting in order to avoid a flume and to insure a permanent ditch.

The Flume

This is so well known and has been used so extensively in California that it seems almost needless to refer to it here. But however that may be, practice is gained by contact and experience, and errors are frequently committed in the earlier history of a work that might have been avoided if it had been possible to impart the experience acquired by those who have had to do similar work.

The author, in his long contact with many different types of flumes, had under his immediate charge for several years one which so completely answered the requirements that it seems justifiable to call attention to it here. This flume was about 8 miles long, 4 ft. wide, 38 in. high, and lay on a steep hillside on a narrow bench that was graded just enough to afford a resting place for the inside of the flume; the outer side was held by props from the bank. This was the condition for nearly all of its length.

This flume (Fig. 5) was built of common yellow-pine lumber, with 1½-in. boards for bottoms and sides; 4x5-in. bottom ties, 6 ft. long; 2x5-in. top ties, 6 ft. long; and 2x4-in. posts, or standards, 4 ft. long; no braces; bottom and top ties mortised for the posts, which were unframed.

This flume was in constant use for 30 years. The portion that rested but partially on the ground was kept in repair at small expense, and its use could have been continued at a nominal expense for several years longer had the market for its water still existed. Aside from renewals due to accidental causes, practically all of the flume that rested on the ground was still the original construction after its long use, and the greater part

of it had not required the replacement of as much as a bottom tie in all that time.

It shows the possibility of a simple construction that one might not have ventured upon, preferring some more elaborate foundation at almost prohibitive cost. The risk proved the perfect practicability in the long and useful life of this simple flume.

A flume may be laid on an excavated bench on sills, projecting over the bank, or it may be erected on a partial trestle work for the support of the outer side. Gulches or deep ravines must be crossed on trestle bridges, as shown in Fig. 5. These bridges, when there is no other alternative in making the crossing, often become very formidable structures.

Short sections of flume should have the same area as the ditch, but long sections may be somewhat smaller, owing to the decreased friction of the water. It is questionable, however, whether a change of size is always justifiable, unless the reach of flume has considerable length, for the reason that it is inconvenient to keep various varieties and sizes of lumber in stock for repairs. If there is considerable repairing to be done, it is better to have only a few different sizes, thereby reducing the stock of lumber kept on hand for repairs. It may be quite practicable to plan the size of the flume in such a way that the same-size lumber answers for both sides and bottoms.

For a conventional flume of the type under discussion, the bottom boards and the sides, where the depth of water does not exceed 3 ft., should be 1½-in. planks; if much deeper, 2-in. boards will be necessary, especially for the bottom. For sills, or bottom ties, 4x5-in. pieces will answer for flumes up to a width of 4 ft. containing a 3-ft. depth of water; for a wider flume, 4x6-in. pieces may become necessary; for a flume 10 ft. wide, with a 4-ft depth of water, it will be well to make them from 6x6-in. lumber. For the top ties, or caps, take 2x5-in. pieces for a 5-ft. flume; 2½x6-in. pieces will answer for one 8 ft. wide where there is little snow. If much snow has to be provided against, the top ties must be correspondingly heavier.

For standards, or uprights, use 2x4-in. lumber for a 2½-ft. depth of water; 2½x 5-in. for a 3½-ft. depth; and 3x6-in. for water 4½ ft. deep. These sizes are all desirable, as they need no framing, the bottom and top ties being mortised through. The standards, cut to proper length, are driven firmly into the bottom tie, which acts as a brace, eliminating the ordinary diagonal brace necessary where the standard is set into a gain in the top of the sill. Another advantage over the latter is that, as the flume becomes old and weak from decay, it is much more stable and also more easily repaired, and it will last longer than the flume in which the side ties are gained into the sills and caps.

In order to prevent the clear water from running over the sides of the flume abrupt turns are to be avoided as far as possible. Where a flume joins the ditch, especially at the upper end of the flume, a small gore should be inserted into one box-length, making it bell mouthed. This will prevent the water from backing up into the ditch, and it will have a tendency to prevent lumber, sticks and floatage from catching across its head. A flared box at the lower end of the flume having a swift current will prevent the ditch immediately below from undue erosion.

Waste-Ways

Waste-ways for turning the water out of the ditch in case of accidents, oversupply from rains or melting snow, or other causes must be provided at intervals along the ditch. They should be placed at points where the escape of the waste water will not result in cutting away the ground below the ditch and endanger its safety.

If the ditch is in a cold country where large amounts of snow will collect in it faster than they can be run through it, or where snow is likely to fill up the ditch when the water is not running, which would have to be sluiced out later, the waste-ways should be at frequent intervals, for it is necessary to get the water out quickly and in time before they become clogged up and break.

All waste-ways should be so constructed that the entire flow can be quickly turned out, and they should be so located that the water may escape without endangering any part of the ditch. Some provision should also be made to keep the freshet water from ravines out of the ditch; if it be impracticable to place these waste-ways at or near the ravines, in order to use them for that purpose, other means must be found to prevent this serious inflow.

In conclusion it may be said that the important point in hydraulic mining is to get as much material into the water as the current will transport through the sluice, and to convey this volume without interruption.

Gold in Western Australia

The Council of Mineowners reports the production of gold in Western Australia in November at 137,000 oz., an increase of 620 oz. over October, but a decrease of 8825 oz. from November, 1907. For the 11 months ended Nov. 30 the total gold output was 1,543,097 oz. in 1907, and 1,508,752 oz.—or $31,185,904—in 1908; a decrease this year of 34,345 oz., or 2.2 per cent.

The Pittsburg Experimental Station

The station for the investigation of mine explosion of the technologic branch of the U. S. Geological Survey, at the Government arsenal grounds, Pittsburg, Penn., which was opened Dec. 3, 1908, comprises the following equipment:

Gas and dust gallery No. 1, 100 ft. long by 6 ft. 4 in. in diameter, has 15 sections of boiler-plate steel, three sections being ½-in. plate, the rest ⅜-in. plate. In each section is a 6x6-in. window of ¾-in. plate glass and a release pressure door. At each lap joint inside is a circular angle iron for holding paper diaphragms to confine air and gas mixtures. Natural gas, from the city mains, containing about 80 per cent. methane and ethane, is used. It is measured by a meter, distributed by a 2-in. pipe, and mixed with air by an electrically driven exhauster. Coal dust is put on rows of shelves on both sides of the gallery.

In the concrete head, is a steel cannon 36 in. long and 24 in. external diameter, having a nickel-steel lining with a 2¼-in. bore 21½ in. deep. The charge is fired electrically from an observation room, about 60 ft. distant, having a window of ½-in. plate glass 6 in. wide and 37 ft. long, protected by external guards.

Gas and dust gallery No. 2 is a round boiler-plate tube, 10 ft. in diameter and 30 ft. long, open at either end.

The flame-testing apparatus comprises a vertical cannon, like that in gas and dust gallery No. 1, in a concrete base, below a boiler-plate stack having a vertical slit from which a light-tight conduit leads to a dark room where the length and duration of the flame from an explosive are photographically recorded on a rapidly-moving sensitive film.

The ballistic pendulum is a United States 12-in. mortar, weighing 31,600 lb., hung by steel rods from an iron beam having nickel steel knife edges resting on nickel-steel plates on massive piers. The length of swing of this mortar from a charge placed in a cannon like that in gallery No. 1, is a measure of the strength of the explosive.

A cable from Johannesburg, dated December 3, 1908 to *The London Mining Journal* announces details of an amalgamation plan embracing the Crown Reef, Robinson Central Deep, Crown Deep, South Rand, Langlaagte Deep and Pearl Central. When the merger is completed, the company will be the largest gold producer on the Rand.

According to *La Nature* a gold-bearing district has been discovered near Tamative, Madagascar.

The Tariff Hearings at Washington

SPECIAL CORRESPONDENCE

A considerable number of additional briefs relating to duties on iron and steel and products thereof have been filed during the past week with the House Ways and Means committee.

PIG IRON

Walter Wood for R. D. Wood & Co., Philadelphia, Penn., presents argument showing that $3 per ton duty above the tariff on pig iron is sufficient protection for the cast-iron pipe business but that a reduction to less than $2 per ton would be unwise. He further asserts that any considerable reduction in the cost of pig iron must come from the lowering of the price of Lake ores and urges that a thorough scheme of drawbacks will tend to bring into the United States a large amount of trade which it could not otherwise obtain. E. C. Felton, President Pennsylvania Steel Company, submits detailed estimates of steel costs and urges that the present rate on steel rails is none too high for the protection of the seaboard manufacturer. A. S. Patullo, secretary of the Oregon Iron and Steel Company, Portland, Oregon, advocates a reduction of the duty on pig iron. Leonard Packitt, Catasauqua, Penn., rebuts the arguments of Colne & Co., New York, against duties on silicon iron. He maintains that there is an abundance of "low phosphorus pig iron"—an identical product. Nelson Lyon, Tarrytown, N. Y., submits an elaborate supplemental argument in favor of free pig iron and free raw material in the coarser products of iron and wire, and detailed data on cost of production. John O. Pew, Vice-President the Youngstown, Iron and Steel Roofing Company, Youngstown, O., suggests a moderate reduction in all the iron schedules and urges the substitution of specific for ad valorem duties in Section 135. R. M. Boutwell, Treasurer Portland Iron and Steel Company, Portland, Me., requests the placing of scrap iron on the free list. Chas. Eugene Clark, Covington, Ky., an iron-founder, asks adequate protection for the smaller producer on the ground that he works at a disadvantage. Hon. Chas. Dick has filed a letter from Edwin G. Hough, Secretary of the Chamber of Commerce, Mansfield, O., in which an advance of the duty on iron shot, steel shot, grit and other iron abrasives from 45 to 75 per cent. is urged. W. F. Boardman, treasurer the Calais Shot Works, Calais, Maine, requests a duty of 1c. per pound on chilled shot of all sizes. W. H. Bowker, Boston, Mass., asks to have sulphate of ammonia and basic slag placed on the free list.

The Bessie Ferrosilicon Company, New Straitsville, O., asks that proper protection be granted to ferrosilicon by removing it entirely from the class of pig iron and putting it with such other ferro-alloys as are made by both the blast furnace and the electric processes. Ferrosilicon whether produced in the electric furnace or by chemical process or otherwise should have a duty of 37½ per cent. on the foreign valuation. W. S. Puling, treasurer the Northern Iron Company, Philadelphia, files charges that the statements of Colne & Co., New York City, relative to silicon iron "are untrue" and urges that there be no tariff discrimination against silicon iron.

LEAD AND ZINC ORES

Marshall J. Smith, Georgetown, Colo., has filed supplemental evidence regarding the need of an adequate duty on lead. C. F. Kendall, manager of the Pay Rock mines, Silver Plume, Colo., furnishes statistics on mining costs pointing to the need of a tariff on lead. Silas Frank, Creede, Colo., urges the retention of the present duties on lead. Frederick Burbidge, representing the lead producers and miners of Idaho, asks the retention of the present duties on lead ore and bullion and supports his argument by citing data from "Lead and Zinc in the United States," by W. R. Ingalls, and from the ENGINEERING AND MINING JOURNAL. A body of citizens of the Cœur d'Alene district urges that the present duty on lead bullion and lead ores be not decreased. Thomas L. Wood, Denver, Colo., has filed a lead-ore settlement sheet showing the proceeds of a carload of concentrates and requests the maintenance of the present tariff on lead.

In a supplementary letter S. S. Palmer, president of the New Jersey Zinc Company, rebuts the arguments of the Joplin interests in behalf of a protective duty on zinc. Charles H. Morris, manager of the Altura Mining and Milling Company, and others, Denver, Colo., protests against any reduction of the tariff on lead and demands duties on zinc. James E. Pope, Jersey City, files a denial of statements made by Edward Brush, of the American Smelting and Refining Company, as to the production and marketing of lead. J. W. Marsh, Pittsburg, Penn., general manager of the Standard Underground Cable Company, urges reduction of the duty on lead ores to 0.75c. per pound and on refined lead to 1.125c. per lb. John B. Winfield, Pueblo, Colo., complains of the difference between Canadian and American prices on white lead. The Hanna Paint Manufacturing Company, Columbus, O., complains of the duty on dry white lead and resulting monopoly.

Axel O. Ihlseng, general manager of the Oronogo Circle Mining Company, Joplin, Mo., submits a lengthy analysis of zinc-ore costs in support of his demand for a duty of 1.5c. per lb. on the zinc contents of imported ores. A. B. Cockerill, Nevada, Mo., modifies his statement about Mr. Ihlseng's relation to foreign zinc interests. The H. H. Franklin Manufacturing Company, Syracuse, N. Y., submits additional material in support of its argument for the reduction or total abolition of the duty on aluminum.

MISCELLANEOUS

The Beckton Chemical Company, Philadelphia, Penn., submits a supplemental brief petitioning that the duty on crude manufactured barytes earth suitable for lithopone manufacture be entirely removed, or at least not advanced beyond the present rate. The W. D. Gilman Company, Sweetwater, Penn., corrects some misstatements and asks for a protective duty of $5 per ton. The Retail Confectioners and Ice Cream Manufacturers Protective Association of New York recommends removal of the duty on rock salt. Hon. Peter A. Porter files a letter from the Rock Glen Salt Company, Rock Glen, N. Y., asking the retention of present duties or increase of 2 or 3c. per 100 lb. on salt above present rates of 8 to 10c. per lb. H. C. Higginson, president of the Higginson Manufacturing Company, Newburg, N. Y., asks retention of the present duty on refined chalk. George W. Grote, importer, New York City, asks that chalk be placed on the free list. Henry Howard, president of the Merrimac Chemical Company, Boston, Mass., submits detailed argument for placing bauxite on the free list. Hugo Reisinger, New York City, urges that the specific duty system as applied to carbons be abandoned and the rate be 20 per cent. ad valorem. H. Y. Seidel, Philadelphia, requests that crucible clay be retained on the free list. A considerable number of manufacturers support this position. The Glidden Varnish Company, Cleveland, O., protests against any increase of duty above the present $1.50 per ton on asphaltum. The Southern Fullers Earth Company, Warren, Penn., urges the need of increased duties on fullers earth and supports the views of Harry A. Auer, who appeared before the committee.

Charles Weiler, Milwaukee, Wis., urges an increase of duty on gypsum rock from 50c. to $1 per ton. The Roman Nose Gypsum Company, Bickford, Okla., requests an advance in the duty on gypsum. Frank W. Wilder, for the Southern Gypsum Company, North Halston, Va., urges that reduction of duties to 25c. per ton would be inadvisable. The Warner-Miller Company, New Haven, Conn., advocates abolition of the duty on gypsum. The Virginia Portland Cement Company, Fordwick, Va., urges free admission of gypsum. The same request is made by a large number of dealers in building supplies. The Best Brothers Keen's Cement Company, Medicine Lodge, Kan., urges that the duties on Keene's cement be raised and be equalized with those on the chemicals used in its production. John C. Lehman, for the Kielgass Lehman Company, Chicago, asks that the tariff on pumice be reduced or certainly not advanced.

THE ENGINEERING AND MINING JOURNAL

Issued Weekly by the

Hill Publishing Company

JOHN A. HILL, Pres. and Treas. ROBERT MCKEAN, Sec'y.
505 Pearl St., New York.
London Office: 6 Bouverie Street, London, E. C., Eng.
CABLE ADDRESS "ENGMINJOUR, N. Y."

Subscription, payable in advance, $5.00 a year of 52 numbers, including postage in the United States, Mexico, Cuba, Porto Rico, Hawaii or the Philippines. $6.50 in Canada.

To foreign Countries, including postage, $8.00 or its equivalent, 33 shillings; 33 marks; or 40 francs.

Notice to discontinue should be written to the New York office in every instance.

Advertising copy should reach New York office by Thursday, a week before date of issue.

For sale by all newsdealers generally.

Entered at New York Post Office as mail matter of the second class.

CIRCULATION STATEMENT

During 1908 *we printed and circulated* 507,500 *copies of* THE ENGINEERING AND MINING JOUENAL.

Our circulation for December, 1908, *was* 42,500 *copies.*

January 2..... 10,000

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

Contents

South African Mining Reports and the Life of the Mines

While the reports issued by the South African Mining companies generally supply the stockholders with ample statistics as to the working of the mines, there is one point on which nearly all of them are deficient. Mining and milling costs and bullion recoveries are given with much detail, and no one can reasonably complain that the results of the year's work are not sufficiently explained. The serious omission is that no information is given as to the probable life of the mine. It is true that in a few cases some estimate is given of the probable date of exhaustion of the ore; but this is the case with only a few of the older mines—such as the Crown Reef, the Ferreira and the Robinson—which have had their lives officially determined, so to speak. This omission is especially to be deprecated in a district like the Witwatersrand, where the determination of ore reserves is more easily made than in any other gold-mining district known.

The dividends of the mines may be regarded as terminable annuities, and unless the reports give some indication of the number of claims to be worked and the probable tonnage, the shareholder is very much in the dark as to the present value of his holdings. Of course, no one who understands how much the tonnage available for mining depends on the cost of working can expect more than an approximate estimate; since the cost must fluctuate according to the labor supply and other causes. It is reasonable, however, that shareholders should obtain from their directors and the engineers they employ the best information possible as to the probable life of their property. The claims worked out and the tonnage obtained are known quantities; so also is the area of claims still unworked. It is, therefore, inexcusable that official reports, while giving copious information about past results and current work, should be totally silent as to the future. It is also remarkable that meetings are held in which shareholders ask many questions, but no one calls for information of the kind indicated.

Of course, the available resources of a mine will vary as conditions change; and a reduction in working costs may make valuable ore formerly considered unpayable. Revaluations must be made from time to time. Moreover, no one can blame engineers for not foreseeing such reductions in cost; or, on the other hand, variations in average ore value, the occurrence of dikes and faults and other factors that may affect the reserves unfavorably. Stockholders have, however, an undoubted right to expect from their engineers and directors a general report on the probabilities, based on conditions existing at the time the report is made; and indicating to the best of their knowledge and experience what may be reasonably expected.

Another phase of the same question relates to the accounts of the companies. In the balance sheets property account remains at the same, or an increased figure year after year, although the value necessarily depreciates with the ore taken out each year. If these property accounts had been debited each year with the ore taken from the mine—as is done by many coal companies in Europe and the United States—either the capital would be reduced to conform to the estimated future profits, or a sinking fund provided for the benefit of stockholders. Either method would provide for the amortization of the capital, and its extinction when the life of the mine was ended.

Ventilation of Mines

Ventilation in metal mines in the United States is a subject that is commonly dismissed from consideration, or rather it seldom enters into consideration at all; at least, not until the air becomes so bad that candles will not burn. Consequently, there is no well developed practice in this important phase of mining. No arguments should be necessary to prove that it is an important phase, because it is axiomatic that the better are the conditions for the men underground, the greater is their efficiency. Nevertheless, operators are frequently blind to such matters that directly affect their own interest, and it is necessary to insure the welfare of their employees by law. So largely has the subject of ventilation been disregarded, there is only one law—that of New York—that in any way prescribes that good ventilation shall be provided, or even refers to it. Fortunately, several of the States require that every mine shall have at least two exits, which in themselves usually effect fairly good ventilation, although not intended specifically for that purpose.

The simplest means for ventilating a mine is the establishment and proper direction of air currents through it. This can usually be effected, when there are two openings to the mine or connection with some other mine, by the exercise of engineering knowledge and the expenditure of nothing but a little thought and the cost of a few doors, brattices, etc. The results of intelligent consideration of the principles governing air currents are strikingly manifest in the mines of Butte, Mont., which through the decomposition of timber and sulphide ore, and the heat generated by pressure in the fissured and fractured ground are as hot as any mines now operated in the United States. Some of the mines at Butte are so hot that an ordinary candle quickly softens in the fingers, and their atmosphere is exceedingly uncomfortable, both because of the heat and the deficiency of oxygen by absence of circulation; other mines near by, while warm, are not uncomfortable to the men, a proper circulation of air through the workings having been established.

A mine having only one opening can, of course, be ventilated only by a mechanical movement of the air, and when the drives attain long distances from the shaft it is necessary to provide air pipes extending nearly to the breasts, and either force in or exhaust air by means of a fan. In some metal mines opened in a flat-lying deposit, where the workings may cover a large area on one level, a simple and effective means for ventilation is to put down one or more 6- to 8-in. holes with an ordinary churn drill and connect them on the surface with a fan which will exhaust air from the mine through the drill holes. Such drill holes are very cheaply put down to depths of several hundred feet.

The subject of ventilation underground is one that should be given a good deal more attention than it gets. It is not right to compel miners to work under conditions which may injuriously affect their health, even if the men themselves be willing to work in such places without complaint. But aside from this moral aspect of the case, it is the common experience that the better are the conditions for work, the more is the work done. Many managers of mills who neglected for years to clean the windows, found to their astonishment that the better light coming from the removal of the dust and dirt increased efficiency to such an extent that window cleaning proved to be one of the best investments ever made. The provision of good air is also a fine investment.

Secrecy in the Arts

The best explanation and defense of this mistaken policy, as we consider it to be, that we have seen, have been given by Edgar Hall, of Australia, in a communication published in the September bulletin of the American Institute of Mining Engineers, wherein he discusses the paper of Dr. Douglas, presented at the Toronto meeting of the Institute. Dr. Douglas attributed the decline of the copper-smelting industry in Swansea to the secrecy maintained by the concerns there engaged in smelting.

Mr. Hall argues that the decline of copper smelting at Swansea was due to quite different causes and was inevitable. He points out that Swansea never smelted what is now considered low-grade ore, and never could hope to do so, because even with the advantage of cheap ocean-carriage, nothing but rich ores and matte could stand the freight. With the introduction of the bessemer process matte could be more cheaply treated at or near the mines.

The smelting industry at Swansea was essentially conducted on a custom basis. Today the great producers of copper are the mining companies which do their own smelting, and as Mr. Hall remarks, "It matters little who knows what is being done, for those who may copy their methods cannot take the mine, and it is decidedly of advantage to the smelter to know what others are doing, since every improvement adopted is pure gain and an increase in the value of the mine. But to the custom smelter very often the possession of a 'wrinkle' means the difference between profit and loss, and in the case of the Swansea firms, if they showed their methods freely, it meant that they would be promptly deprived of their supply of raw material."

Undoubtedly there is some truth in this argument, but its mistake on the whole lurks in what Mr. Hall himself says, namely that it is of advantage to the smelter to know what others are doing, since every improvement adopted is pure gain. Such advance in knowledge is only to be secured through an exchange of information. We should feel sorry for the metallurgical firm whose chief capital was a trade secret, always at the risk of betrayal of a venal employee. The concern which has failed to develop an organization and a guiding policy that will permit it to discard its old clothes to less enterprising competitors, from whom nevertheless it may obtain fragments of valuable experience in exchange, is not likely to keep a position near the head of the procession. This, we think, is verified by the often repeated experience, that when after much trouble an opening is finally gained to previously inaccessible works, it turns out that the veil of mystery has concealed defects in practice rather than the perfection supposed.

The Low Price for Silver Affects the Cost of Producing Lead

We are apt to fall into error of speaking of silver as a by-product that will be turned out irrespective of the price in so far as it is derived from lead and copper ores, but whether the silver of such ores be let go scot-free, or the silver be charged with all it realizes in order to make the copper and lead stand at a low cost, or expenses be proportioned among these various metals, is merely a matter of bookkeeping. The fact is, of course, that a decline in the value of silver has a highly important effect upon the cost of producing the other metals, particularly important in the case of the lead mines of the Cœur d'Alene.

Thus, it was computed in an article in the JOURNAL of Jan. 4, 1908, that if the price for silver should fall from 68c. per oz. to 50c., the cost per pound of lead to the Federal Mining and Smelting Company would increase approximately 0.67c., while the Bunker Hill & Sullivan company which at 67.5c. per oz. for silver realized for that metal alone an amount much in excess of the total cost of mining and milling, would fall far short of that exceptional and desirable result if the price for silver should be only 50c. per ounce.

However, with silver at a little less than 50c. per oz. the wolf is not howling at the door of these great lead producers, which on the basis of 50c. per oz. can deliver lead in New York at 3@4c. per lb., including all charges for maintenance, amortization, etc., while if those items were neglected for a time as would be done at a pinch, the cost of production would be 0.5c. per lb. less.

Patent Legislation

SPECIAL CORRESPONDENCE

Representative Stephens has introduced in Congress a bill requiring any citizen of a foreign country who may procure a copyright or letters patent from the United States to pay to the United States for such copyright or patent the same amount of fees and to subject himself to the same laws, rules and regulations relating to such patent, its use and control, as the government of such foreign country exacts by its laws and regulations from citizens of the United States. This is the same proposal which was brought up last spring and at that time received considerable attention from the House Committee on Patents. It was then seriously antagonized by the patent attorneys of the United States on the ground that it would require an immense enlargement of the work of the patent office and throw upon our courts the necessity of familiarizing themselves with the patent legislation of many foreign countries, in addition to numerous technical objections to the proposed measure. The same position is now being taken by the patent attorneys and they are expecting to have hearings before the House Committee on Patents probably during January at which the Stephens bill will be considered and there will be general discussion of methods of retaliation against foreign countries which accept legislation aimed at American interests.

The Conservation Commission

SPECIAL CORRESPONDENCE

It has been determined to send to the President the *verbatim* proceedings of the conservation conference as a part of the report of the Conservation Commission. President Roosevelt will then transmit the whole mass of documents to Congress early in January, and this will insure the publication of the whole as a government document. The President will also make recommendations for a permanent body to take charge of the conservation movement, but no legislation is expected at this session.

Mr. Pinchot will shortly appoint the permanent conservation committee (of voluntary type) which was provided for at the recent meeting of the conservation conference. This consists of six members of State conservation commissions and three members of the national body. It is expected that this joint organization will begin operations at once in conjunction with the various State conservation commissions and will aid in formulating uniform legislation to be urged upon the several State legislatures that will be in session this winter.

Chronology of Mining, December 1908

Dec. 2—American Mining Congress met at Pittsburg, Penn.

Dec. 3—Experimental station of the U. S. Geological Survey at the Arsenal grounds, Pittsburg, Penn., formally opened by Secretary Garfield. Guanajuato-Jalisco Development Company organized in New York.

Dec. 7—Congress reassembled.

Dec. 8—National Conservation Commission made its first report. President Roosevelt and President-elect Taft advocated the issue of bonds to protect the natural resources of the country.

Dec. 10—President Roosevelt withdrew from entry all public lands containing phosphate rock in Wyoming, Idaho and Utah. Conference of steel manufacturers at New York, but no action as to prices. Violent break in price of Rawhide Coalition stock.

Dec. 11—Announcement that Phelps, Dodge & Co., Incorporated, capital $50,000,000, is to take over all the interests of the firm of the same name. The President-elect, William H. Taft, announced that there will be thorough tariff revision. Announced that on Jan. 1, 1909, the railways will raise freight rates an average of 10 per cent. on east-west shipments and 18 per cent. on west-east.

Dec. 15—Mexican Congress adjourned until April without taking action on new mining regulations. Federal Mining and Smelting Company resumed dividends on common stock.

Dec. 16—Fire in quarters of the U. S. Geological Survey at Washington destroyed a quantity of field notes and other valuable documents. C. W. Bray, president of the American Sheet and Tin Plate Company, resigned. Edward Brush, treasurer of the American Smelting and Refining Company, declared before the Ways and Means committee that American lead producers need protection against Mexican producers.

Dec. 17—Announcement that Cole & Ryan will organize new smelting company to compete with American Smelting and Refining Company.

Dec. 18—Copper producers met at New York to consider revival of statistical association. Giroux smeltery at Kimberly, Nev., burned. E. H. Gary, of the U. S. Steel Corporation, before the Ways and Means committee pleaded for the retention of the present tariff on steel products.

Dec. 21—Andrew Carnegie declared before the Ways and Means committee that the American iron and steel industry no longer needs protection. Incorporation of International Smelting and Refining Company (the Ryan-Cole company), with capital of $50,000,000, all common stock. Manufacture of steel begun at Gary, Ind.

Dec. 26—President Roosevelt appointed commissioners to consult with authorities of Canada and Mexico regarding the conservation of natural resources.

Dec. 28—Earthquake in southern Italy and Sicily destroyed thousands of lives and millions of property.

December Dividends

The accompanying table shows the dividends paid in December, 1908, by mining and industrial companies in the United States and by some foreign mining companies.

U. S. Mining Companies.	Location.	Amt. per Share.	Amt. Paid.
Acacia	Colo.	$0.01	$15,000
Am. Smelters, pfd. A.	U. S.	1.50	225,000
Am. Smelters, pfd. B.	U. S.	1.25	375,000
Bunker Hill & Sull.	Ida.	0.25	75,000
Calumet & Arizona	Ariz.	1.00	200,000
Calumet & Hecla	Mich.	5.00	500,000
Colorado	Utah	0.08	80,000
Doe Run	Mo.	1.50	93,720
Federal Sm'ting, pfd.	Ida.	1.75	210,000
Homestake	S. Dak.	0.50	109,200
Mary McKinney	Colo.	0.02	26,185
North Butte	Mont.	1.00	400,000
North Star	Cal.	0.75	187,500
Old Dominion	Ariz.	0.50	146,622
Old Dominion M. & S.	Ariz.	1.00	162,000
Quincy	Mich.	1.00	110,000
Round Mountain	Nev.	0.04	10,000
Sioux Con.	Utah	0.02	10,000
Standard Con.	Cal.	0.10	17,839
Tomboy	Colo.	0.48	144,000
Uncle Sam	Utah	0.02	10,000
Utah (Fish Sp'gs.)	Utah	0.04	4,000
Utah Copper	Utah	0.50	362,975
Total			$3,484,041

U. S. Industrials.	Location.	Amt. per Share.	Amt. Paid.
Gen. Chem., com.	U. S.	$1.00	$74,103
Maryland Coal, pfd.	Md.	2.50	47,125
National Lead, pfd.	U. S.	1.75	260,820
Northern Coal and Coke	W. Va.	3.50	87,500
Sloss-Sheffield, com.	Ala.	1.00	100,000
Standard Oil	U. S.	10.00	9,700,000
U. S. Steel, com	U. S.	0.50	2,541,513
Total			$12,811,061

Foreign Mining Companies.	Location.	Amt. per Share.	Amt. Paid.
Granby	B. C.	$2.00	$270,000
Kerr Lake	Ont.	0.15	90,000
Mines Co. of America.	Mex.	0.02	40,000
N. Y. & Hond. Ros.	C. A.	0.10	15,000
Silver Queen	Ont.	0.03	45,000
Trethewey	Ont.	0.10	94,545
Total			$554,545

The lead-smelting works now in operation in Colorado are those of the Ohio & Colorado Smelting Company, at Salida, and the Globe, Pueblo, Arkansas Valley and Durango plants of the American Smelting and Refining Company. The Grant works, at Denver, and the Philadelphia plant, at Pueblo, are permanently abandoned. The chances are also that the Eilers plant, at Pueblo, now idle, will never run again.

The Simmer & Jack Gold Mine in the Transvaal

SPECIAL CORRESPONDENCE

During the year ended June 30, 1908, at this mine 785,310 tons were crushed, yielding gold to the value of £1,267,410, an average of 7.672 dwt. or $7.75 per ton. The working expenditure was $3.89 per ton. During the year 4000 Chinese laborers were replaced by negroes, a change which entailed heavy expenditure. The mill consists of 320 stamps and four tube mills, the average duty being 6.969 tons per stamp day.

During the year underground work on night shift was gradually reduced until at the end of June practically the whole mine was operated on day shift only, resulting in general improvement in efficiency.

One notable omission from the report and from the chairman's speech at the annual meeting is any statement regarding the life of the mine. No attempt has been made to indicate the claims exhausted, or what remains. For additions and renewals of machinery and plant a reserve fund is maintained. For the period under review the sum of £52,500 was appropriated for this fund, which stood at £83,630 at the end of the financial year.

The net revenue on working account was £601,067. Two dividends of 7½ and 10 per cent., as well as a bonus of 2½ per cent. were declared, absorbing £600,000 in all.

The following statement shows the working costs per ton since 1905.

Year to June 30:	1905.		1906.		1907.		1908.	
Tons milled	475,181		624,507		717,524		785,310	
	s.	d.	s.	d.	s.	d.	s.	d.
Mining, hauling and pumping	14	2.759	12	4.147	11	0.527	8	10.774
Transport of quartz, crushing and sorting		11.425		10.039		9.634		6.080
Milling and cyanide	4	1.106	3	8.592	3	5.625	3	7.948
General expenses, including maintenance	1	6.362		11.984	1	6.515	1	4.926
Development	2	6.000	2	6.000	2	6.000	1	8.918
Total costs	23	3.652	20	4.762	19	4.301	16	2.646

Development account is a book entry, calculated from the tonnage developed in the mine divided by the cost. On June 30, 1908, excess development stood in the books at £115,417, against a tonnage of 1,902,000 tons valued at 7.6 dwt. equal to $0.29 per ton.

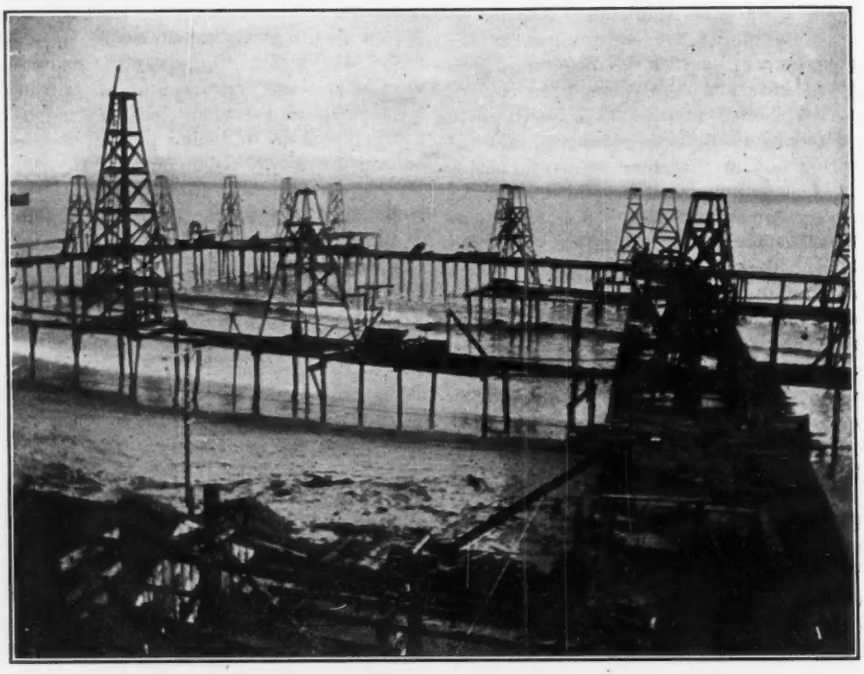
Since 1905 the total tons developed have been as follows:

	Tons.	Value.
1905	1,216,064	8.44 dwt.
1906	1,215,291	8.4 dwt.
1907	1,694,000	7.7 dwt.
1908	1,902,000	7.6 dwt.

It is usual on the Rand to aim at the extinguishment of development expenditure in the balance sheet by writing off every year to working costs a somewhat larger amount than has actually been spent during the year. Shafts and property, on the other hand are not written down and the expenditure remains the same in the balance sheet from year to year unless additions are made.

Submarine Petroleum

The story of the present article is told in the engraving from a photograph which accompanies it. This shows an oilfield at Summerland, Cal., where petroleum is obtained from submarine wells. So far as we are aware the situation of these wells is unique in the petroleum industry.



SUBMARINE OIL WELLS, SUMMERLAND, CAL.

Proposed Tax on Mining Stocks

SPECIAL CORRESPONDENCE

In considering new revenue legislation, the Ways and Means Committee is being urged to investigate the question of a tax on the stocks of corporations engaged in interstate business, and in this connection the McHenry bill introduced May 12, 1908 (H. R. 22,267), as well as other measures aimed at stock speculation, will be pressed upon the committee. The McHenry bill provides "that on and after the approval of this act all corporations engaged in the mining of asphalt, copper, gas, gold, graphite, iron, lead, oil, radium, silver, tin or zinc, or corporations organized for the purpose of mining or producing those minerals and offering stock of such corporations for sale either in commercial exchanges, boards of trade, or by private subscription and solicitation, shall pay into the treasury of the United States a tax of 0.1 per cent. upon the market value not reckoned below par, of the authorized capital stock of such corporations." The Ways and Means Committee has not committed itself thus far to any scheme of revenue enlargement, but the pressure for the McHenry bill or some measure of the same sort is likely to be strong.

Rhodesian Mines

The gold production of Rhodesia in October is reported at 48,847 oz., or 274 oz. more than in September. For the 10 months ended Oct. 31 the total was 503,447 oz. This year nearly all the mines report in fine gold, but last year the statements were made in bullion. By values the gold outputs for the 10 months was $8,786,515 in 1907, and $10,278,512 in 1908; an increase this year of $1,491,997, or 17 per cent.

The production of other metals and minerals in October included 24,615 oz. silver, 9 tons copper, 85 tons lead, 7 tons wolframite, 386 tons chrome ore and 16,312 tons coal.

West African Gold Mines

The West African Chamber of Mines reports gold production in Ashanti and the Gold Coast in November at 24,437 oz., an increase of 656 oz. over October. For the 11 months ended Nov. 31, the total was 269,287 oz. bullion in 1907, and 272,742 oz. in 1908; an increase of 3455 oz. The bullion reported in 1908 was equal to $5,295,323, or 256,184 oz. fine gold.

New Publications

THE MOUNT FARRELL MINING FIELD. By L. K. Ward. Geological Survey Bulletin No. 3. Pp. 120, illustrated. 5½ x8½ in.; paper. Hobart, Tasmania, 1908: Department of Mines.

BUECHER-VERZEICHNIS DES VEREINS FUER DIE BERGBAULICHEN INTERESSEN IM OBERBERGAMTSBEZIRK DORTMUND ZU ESSEN. Third Edition. Pp. 491. 7½ x10½ in.; cloth. Berlin, 1908: H. S. Hermann.

REPORT OF THE PENNSYLVANIA DEPARTMENT OF MINES, 1907. Part I—Anthracite; Part II—Bituminous. Pp. 603-938, illustrated. 6x9½in.; cloth. Harrisburg, Penn., 1908: Harrisburg Publishing Company.

MARYLAND MINERAL INDUSTRIES, 1896-1907. By William B. Clark and Edward B. Mathews. Vol. VIII, Part II. Pp. 223, illustrated. 7x10 in.; paper. Baltimore, 1908: Maryland Geological and Economic Survey.

INFORME PRELIMINAR SOBRE LA ZONA PETROLIFERA DEL NORTE DEL PERU. By V. F. Marsters. Boletin Del Cuerpo de Ingenieros de Minas del Peru, No. 50. Pp. 150, illustrated. 6¼x9¼ in.; paper. Lima, 1907: Ministerio de Fomento.

THE COPPER-MINING INDUSTRY AND THE DISTRIBUTION OF COPPER ORES IN NEW SOUTH WALES. Second Edition. By J. E. Carne. Mineral Resources No. 6. Pp. 425, illustrated. 6x9¾ in.; board covers. Sydney, 1908: Department of Mines.

PRELIMINARY REPORT ON THE COALINGA OIL DISTRICT, FRESNO AND KINGS COUNTIES, CALIFORNIA. By Ralph Arnold and Robert Anderson. U. S. Geological Survey, Bull. No. 357. Pp. 142, illustrated. 6x9 in., paper. Washington, 1908: Government Printing Office.

THE KETCHIKAN AND WRANGELL MINING DISTRICTS, ALASKA. By Fred E. Wright and Charles W. Wright. U. S. Geological Survey, Bull. No. 347. Pp. 210, illustrated. 6x9 in.; paper. Washington, 1908: Government Printing Office.

COAL: Part I—Coals of the Monongahela Formation or Upper Productive Coal Measures; Part II—Chemical Analyses and Calorific Tests of the Clarion, Lower Kittanning, Middle Kittanning and Upper Freeport Coals. Geology by J. A. Bownocker; Chemistry by N. W. Lord and E. E. Somermeier. Pp. 342, illustrated. 6½x9½ in.; cloth. Columbus, Ohio, 1908: Geological Survey of Ohio.

A TEXT BOOK OF PHYSICS. Edited by A. Wilmer Duff. Pp. 680; illustrated. 5½x8 in.; cloth, $2.75. Philadelphia, 1908: P. Blakiston's Son & Company.

This work is the result of the collaboration of seven distinguished American physicists, the idea being that its important subject would best be treated by specialists. Such an undertaking is apt to be characterized by lack of coördination. In the present case the editor deserves congratulation upon his success in welding the contributions into a uniform treatise. Mechanics and properties of matter are treated by Professor Duff; heat by Professor Guthe; wave motion and sound by Professor Hallock; light by Professor Lewis; electricity and magnetism by Professor Goodspeed; electromagnetic induction by Professor Carman; and conduction of electricity through gases and radioactivity by Professor McClung. The work is in all respects uptodate and is a valuable contribution to knowledge. It appears to us as likely to meet the needs of students for a modern textbook of this science.

ROCKS AND ROCK MINERALS. By Louis V. Pirsson. Pp. 414; illustrated. 5x7½ in.; cloth, $2.50. New York, 1908: John Wiley & Sons, London, Chapman & Hall, Ltd.

Contents: Scope of petrology; historical; methods of study. Chemical character of the earth's crust and its component minerals. Important properties of minerals. Description of the rock-making minerals. Determination of the rock-making minerals. General petrology of igneous rocks. Description of igneous rocks. Origin and classification of stratified rocks. Description of stratified rocks. Origin, general characters and classification of the metamorphic rocks. Description of metamorphic rocks. The determination of rocks.

This is an uncommonly good book upon a subject that is troublesome to all but the trained petrologists. It will be particularly useful to geologists and mining engineers because of the table for determining rocks like those for determining minerals by their physical properties.

STEAM POWER PLANT ENGINEERING. By G. F. Gebhardt. Pp. 816; illustrated. 6x9¼ in.; cloth, $6. New York, 1908: John Wiley & Sons; London, Chapman & Hall, Ltd.

Contents: Elementary steam power plants. Fuels and combustion. Boilers. Smoke prevention, furnaces and stokers. Superheated steam and superheaters. Coal- and ash-handling apparatus. Chimneys. Mechanical draft. Steam engines. Steam turbines. Condensers. Feed-water purifiers and heaters. Pumps. Separators, traps and drains. Piping and pipe fittings. Lubricants and lubrication. Finance and economics; cost of power. Testing and measuring instruments. Typical specifications. Typical plants. Tables. Bibliography.

The author of this work is professor of mechanical engineering at the Armour School of Technology. It is intended to be primarily a textbook for engineering students, but it is hoped that it will also be of interest to practicing engineers. It will be. It is indeed a monumental work, which, while covering much of the same ground as Professor Hutton's classic, looks at its subject from a different viewpoint and contributes important supplemental information.

ELECTRO-METALLURGY. By John B. C. Kershaw. Pp. 303, illustrated. 5½x8½ in.; cloth, $2. New York, 1908: D. Van Nostrand Company.

This book is interesting in many respects and a good deal of valuable information may be obtained from it if the reader be sufficiently well informed to sift out and reject the frequent inaccuracies and belated data. The plan of the author has been too ambitious. In writing a treatise on electrometallurgy in 297 pages and going into such subjects as glass, graphite, carbon bisulphide and others that do not belong to electrometallurgy, there remains obviously an inadequate space for the important subjects like aluminum, copper and iron.

The author's treatment is purely descriptive; in no respect critical and analytical. For example, in his chapter on zinc he describes certain of the hydro-electrometallurgical processes, but fails to indicate the causes of the failure of most of these, or point out that they are bound to fail unless the anode reaction can be utilized, as in the Hoepfner process, or extraordinarily cheap power be available. His explanation of the failure of the Ashcroft process at Cockle Creek is woefully inadequate. Similarly in the matter of the electrothermic processes the data cited are visionary and the great metallurgical difficulty experienced by De Laval, who is the only one that has commercially produced zinc in this way, is not even mentioned.

The chapters on copper and lead are hopelessly out of date. Merely as illustrations we may mention that the Anaconda refinery has not been operated for years, while in the case of the Betts lead process the most important works employing it, namely, Grasselli, is not referred to. Indeed, Mr. Kershaw's book has the appearance of preparation several years ago and publication after a long delay without any serious attempt at revision. In the meanwhile progress has been rapid. The book is obviously to a large extent a compilation, but the best authorities have not always been consulted although their works have been available. The estimate that it costs 25c. per lb. to produce aluminum will provoke a smile in these days when it is selling for 13½c. If such errors were few and obviously mere slips on the part of the author, who cannot be expected to show omniscience, we should not so strongly call attention to them, but unfortunately the book is permeated with them, which deprives it of value except to the discriminating reader, and he is likely to decline to do the sifting that the author ought to have done

Personals

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

S. F. Shaw is in Tombstone, Arizona.

W. de L. Benedict is in San Francisco.

Henry S. Washington has returned from Brazil.

Paul R. Hare is managing a dredge at Pierce, Idaho.

Walter H. Bunce has gone to Argentina on professional business.

Rene Hazard is operating a hydraulic mine near Medellin, Colombia.

Lester W. Strauss has been examining coal and copper in southeastern Peru.

E. B. Kimball and Louis Decoto are investigating mines near Zaragoza, Colombia.

Raymond Linton is examining quartz and placer mines near Tuquerres, Colombia.

F. J. Siebel is superintendent of the Burlington mine at Sutter Creek, Amador county, California.

F. T. Havard has opened an office as consulting mining and metallurgical engineer at Helena, Montana.

Hugh Rose, superintendent of the Guanajuato Development Company, Guanajuato, Mexico, is visiting New York.

James Gallagher has resigned his position as manager of the Joplin Mining Exchange at Joplin, Mo., to go into private business.

P. L. Williams, Jr., general superintendent of the Daly-West mine at Park City, Utah, has returned to Utah from a business trip to Chicago.

Lafayette Hanchett, general manager of the Newhouse interests in Utah, has returned to Salt Lake City from a business trip to New York and Boston.

John V. N. Dorr, of Pluma, S. D., is acting as consulting engineer for the Golden Reward Mining Company in the installation of a Moore process plant.

Joseph Wharton, the veteran ironmaster and blast-furnace operator, has presented a tract of 25 acres at Fern Rock to the city of Philadelphia, to be used as a public park.

H. C. Cutler, consulting engineer for Nixon & Wingfield, has returned to Goldfield, Nev., after three weeks spent in examining mining claims in Sonora, Mexico.

W. F. Battersby, of the Kingston School of Mines, has been awarded the prize of $100 offered by J. B. Tyrrell, mining engineer, Toronto, for the best collection of Ontario minerals made during the past season.

F. W. Ridley has been appointed superintendent of the Allouez and Centennial mines in the Lake Superior copper district. Mr. Ridley has had charge of the Superior, LaSalle and Gratiot properties since they came under the management of the Calumet & Hecla.

Dr. George E. Ladd has been appointed president of the new Oklahoma School of Mines, at Wilburton, Okla., and will take charge soon of the organization. Dr. Ladd was formerly in charge of the Missouri School of Mines at Rolla, but for some years past has been engaged in zinc mining in the Joplin district.

John Laing, of Sharon, Kanawha county, president of the Wyatt Coal Company, and for several years interested in the Rush Run operation on New river, has been appointed chief mine inspector of West Virginia in place of James W. Paul, who resigned some time ago to accept a position with the United States Geological Survey. Mr. Laing began life as a miner and gradually worked his way up until he became an operator on a considerable scale.

Obituary

Henry Wallace Caldwell, president of the H. W. Caldwell & Son Company, of Chicago, and founder of the business, died Dec. 22, at Redlands, California.

Societies and Technical Schools

American Institute of Mining Engineers—The following committee on the Conservation of Natural Resources has been appointed to coöperate with the National Commission; John Hays Hammond, chairman; T. H. Watkins; Gardner F. Williams; James Douglas; Walter Renton Ingalls; Charles Kirchhoff; Theodore Dwight; Joseph Struthers.

Colorado School of Mines—President Victor C. Alderson, of this school at Golden, Colo., announces that a number of courses will be added, beginning with the college year 1908-1909. They are intended for technical graduates who wish to specialize along various lines, The new courses include coal mining; coal testing; mine-plant testing; advanced general metallurgy; metallography; gas-engine design; kinematical drawing of mining machinery; advanced mine and mill design; advanced hydraulic design; ceramic geology; cements and clays; chemistry of the rare metals; electrochemical analysis and experiments; radio-activity and spectroscopy; practical astronomy; precise surveying and geodesy; microscopic petrography; electricity applied to mining.

Imperial Pei-Yang University—The professor in charge, N. F. Drake, has issued an excellent pamphlet of instructions for the use of the students in the mining school of this institution at Pei-Yang, China, who are engaged in field work. The course of study required comprises careful and detailed observations, note-taking and sketching of metallurgical and mining methods and plant and geological features, such as will lead to a general practical knowledge of the subject. It is intended that the work as outlined shall be divided among these subjects as local conditions and opportunity may offer. The list of subjects covered is comprehensive, and is divided as follows: 1. Metallurgy, including: (*a*) Iron and steel plants; (*b*) Coal washing and coking plants; (*c*) Lead and copper smelters; (*d*) Cyanide plants; (*e*) Ore-dressing plants. 2. Mining, including: (*a*) Drilling and blasting; (*b*) Stoping ore and breaking coal; (*c*) Development and working the mine; (*d*) Handling and transporting ore; (*e*) Timbering; (*f*) Shaft sinking; (*g*) Drainage; (*h*) Ventilation; (*i*) Lighting; (*j*) Surface plant; (*k*) Handling men; (*l*) Water supply; (*m*) Organization; (*n*) Supplies and material. 3. Geology includes: (*a*) Local geology and topography; (*b*) Ore deposits; (*c*) Coal beds; (*d*) Miscellaneous economic products.

American Chemical Society—The 39th general meeting was held in Baltimore, Dec. 29-Jan. 1, in connection with that of Section C of the American Association for the Advancement of Science. The meeting was divided for the reading of papers and discussion into nine sections. Among the papers read in the division of Industrial Chemists and Chemical Engineers were the following:

1. Walter O. Snelling. The Munroe Crucible.

2. Percy H. Walker and H. A. Whitman. Rapid Analysis of Babbitt Metal.

4. Allerton S. Cushman. Acceleration Tests of the Resistance to Corrosion of Iron and Steel.

5. David T. Day. The Changes in Crude Petroleum Effected by Diffusion through Clay.

6. George Auchy. Further Remarks on Vanadium and its Estimation.

7. Paul N. Clancy. Iron, from a Chemical and Commercial Standpoint.

9. W. H. Walker. Principles Underlying Efficient Grinding and Separating.

10. H. J. Skinner. The Purchase of Material on Specification.

14. E. G. Bailey. Accuracy in Sampling Coal.

20. Charles E. Munroe. The Commercial Manufacture of Amorphous Calcium Phosphide.

21. Charles E. Munroe. The Distribution of Nitrate of Soda in the United States.

In the Fertilizer Chemistry division papers were presented by George D. Leavens on Determining the Availability of Phosphoric Acid in Basic Slag; by F. P. Veitch on Determination of Iron and Aluminum in Phosphate Rock; by Lucius P. Brown on the Chemistry and Geology of the Inland Phosphates of the United States.

Special Correspondence from Mining Centers

News of the Industry Reported by Special Representatives at San Francisco, Butte, Goldfield, Nev., and London, England

REVIEWS OF IMPORTANT EVENTS

San Francisco

Dec. 24—The counties around the bay of San Francisco have been experiencing unusually cold weather the past week and a thermometer at 36 deg. has been giving many a surprise. In the mountain and foothill counties there have been heavy snows, greatly to the delight of the mining communities, for this insures a summer water supply. Some of the power plants have been frozen up for a time. In the oilfields of Kern and Fresno counties they have had temperatures of 20 and 27 deg., which is most unusual. The miners throughout the State are hoping for more snow and cold weather so that the snow supply may be added to and none now fallen melted. Cold weather has been experienced throughout the State, south as well as north. A few small but unwelcome earthquakes have been experienced in the bay region, just as a reminder that we are still on that "fault line" which slid so badly in 1906.

The Anti-Débris Association at Sacramento is again active in beginning suits against miners who are hydraulicking or ground-sluicing. Agents or "spies" of the association have been bringing in reports of operations of the miners. The district attorney of Sacramento has agreed to prosecute the suits instituted, and proceedings have been commenced against 65 miners at Gold Run, Placer county. The suits are to enjoin the miners from depositing débris in the American river and petition for a writ of injunction; this injunction has been issued against all these men. Not only hydraulic miners operating under a federal license issued by the California Débris Commission are involved, but those working with ground sluices. These latter do not come under the provisions of the Caminetti law, but are to be prosecuted under the common law.

Suits are also to be brought in Sutter county against miners along the Bear, Feather and Yuba rivers in three different counties. A large number of gravel mines will be affected by these suits. It has come to such a pass that numerous miners have written to the Anti-Débris Association asking whether they would be allowed to mine by hydraulic process and under what conditions. Yet the Anti-Débris Association has no official standing and is composed merely of private citizens opposed to mining. Meanwhile there is in existence a federal commission appointed by the President of the United States under instructions from Congress, which is authorized to issue permits to mine by hydraulic process when suitable restraining works are built. The Anti-Débris Association ignores these legal permits or licenses, pays no attention to them, and brings suits where licenses to mine have been issued with all due forms of law. And now the miners go to the association instead of to the commission to find whether or not they can mine. The association intends during the winter to carefully control the hydraulic field and see that no new hydraulic mining is commenced.

Several creditors have filed a petition in the U. S. District Court asking that the Northern California Gold Mines Company be adjudged an involuntary bankrupt.

Mining affairs are more than active in certain portions of Inyo county at present. The Monster mine near Big Pine has been sold to Eastern men. L. T. Oddie, of Tonopah, has bonded and leased the Wright lead-silver mine in the White mountains about 12 miles from Big Pine. Ore will be shipped to the new smelter of the Four Metals Company at Keeler. Hagerman & Todd, of Colorado Springs, Colo., are opening a copper claim in the Argus range near Ballarat. In the Argus range a new district is being formed to be known as Custer. Chedago, the Shive Unthank lease, is beginning to pay. This lease is in the Taylor & Cummings property. New silver-lead prospects are being opened in the Modoc group lying north of Cerro Gordo. At Skidoo there is more ore ready than the custom mill can handle.

There is a good deal of activity in Butte county especially on the Magalia ridge. Several large companies are at work in the gravel channels of that vicinity. The Mesilla Gravel Company is about starting in on its property on the same channel where the Cape Horn company is operating. The Cohen property on the same channel is being exploited.

The old Hewel ranch on the upper Stanislaus river, eight miles above Oakdale, opposite and above the Orange Blossom colony, has been sold to H. C. Norris and Chas A. Marsh, of Los Angeles and John Horning, of Chicago. The property consists of 1600 acres, of which about 400 acres are supposed to carry auriferous gravel in paying quantities if mined by dredges. The ground has been partially tested and the purchasers intend to install a gold dredge.

The Payne ground near Trinity Center in Trinity county is being prospected by Oroville men with a view to purchase should the gravel be rich enough to pay for dredging.

W. S. Kendall has brought suit to enjoin the El Dorado Dredging Company, of Folsom from asserting any right or title to certain lands owned by him. He says he entered into an agreement with the company giving it the right to dredge the Ingleside fruit farm and the Home farm for gold. He alleges that the company did not begin work according to the agreement and because of this failure he says the agreement became null and void. The El Dorado company recently sold its entire interest to the new Consolidated Company.

Goldfield, Nevada

Dec. 22—Figures from the office of the State bullion-tax collector show that during the first 9 months of 1908 Esmeralda county produced $3,886,257. Of this total the Florence Goldfield produced $2,132,225; the Goldfield Consolidated produced only sufficient ore to run the Combination mill, for no general stoping will be done until the new 600-ton mill is running. The Florence Goldfield has produced no ore on company account during this time; all its production came from leases.

The oil excitement between Goldfield and Blair continues, although only one company is doing any extensive drilling. It claims to have obtained a small quantity of oil and feels confident that the hole is about to enter the oil-bearing stratum. An accident to the drilling outfit will delay work for about two weeks.

The first ore to be stored in bank vaults in Goldfield in several months is that being mined by Mitchell & Fairfield from the Daisy-Florence lease. Some of this ore is valued at $5 per pound. Only ore that shows ribbons of free gold is being taken to the bank, although the ore as it is broken averages between $200 and $500 per ton. Another rich strike in the company workings of the Florence centered public attention again on this property, which since its discovery in 1904 has produced nearly five and a half million dollars, all but about half a million of which has come from leases.

Mina has been visited by a fire which swept the central portion of the town. The damage was about $100,000.

The Great Western mine at Hornsilver, which, from a rich silver mine, is developing into a rich gold mine, is being exam-

ined by engineers hired by Baltimore and Kansas City men.

The Clermont shaft of the Goldfield Consolidated company has cut the Mohawk vein at a vertical depth of 856 ft. This is at a depth of 1250 ft. on the plane of the vein which dips 35 deg. The ore along the hanging wall is reported to assay $22 per ton.

Butte

Dec. 24—E. P. Matthewson, general manager, and C. H. Repath, construction engineer, of the Washoe smelter at Anaconda, have returned from a trip to Tooele, Utah, where they were engaged in laying the plans for the new Cole-Ryan smelter. They state that arrangements have been made for laying out the site of the smelter and for erecting temporary quarters for those carrying on the work.

Announcements of the annual meeting of the Montana Society of Engineers have been sent out by Secretary C. H. Moore, of Butte. The society will meet at Great Falls and will be in session Jan. 7, 8 and 9. Nominations for officers for the coming year are as follows: For president, Charles H. Bowman; for vice-president, Frank M. Smith; for second vice-president, F. W. C. Whyte; for secretary and librarian, Clinton H. Moore.

Deputy State Mine Inspector W. B. Orem, in charge of the Butte district, has made his report for the year 1908. The report calls attention to the remarkable increase in the use of electric power for hoisting and pumping purposes in the Butte mines within the past year, and the consequent betterment of ventilation, especially in the deeper mines. It is stated that the substitution of electric power for steam has in several instances reduced the temperature in the mines as much as 20 deg. F. Among the 10,000 men working during the past year but 10 have met death by accident, a decrease of almost 50 per cent. from 1907.

The case of the United States against the Northern Pacific Railway, the Northwestern Improvement Company and the Rocky Fork Coal Company, will be heard in the Federal Court at Helena on Jan. 11. The action is brought by the Government for the purpose of setting aside the title of the defendants to certain coal lands in Carbon county, Mont., valued at $100,000. In the complaint it is alleged that the lands were obtained from the Government by fraud.

London

Dec. 21—In the JOURNAL of Sept. 26 the litigation between the British Ore Concentration Syndicate, Ltd., and A. Stanley Elmore and the Minerals Separation, Ltd., was referred to, and your readers were informed that the Ore Concentration Company failed to prove that the Mineral Separation process was an infringement of its patent, but that the case would be appealed in a higher court. The judgment of the Court of Appeal has now been given and is in favor of Elmore and the British Ore Concentration Syndicate. There were two patents involved in this action, that granted to Francis Edward Elmore, No. 21948 of 1898, in which concentration of metalliferous particles in ores is to be effected by the use of thick oil; and second, that granted to Alexander Stanley Elmore, No. 6519 of 1901, in which the use of all oils thick and thin, though preferably thick, is referred to, as well as the advantage of using a small quantity of acid. The 1901 patent is a much wider specification than that of 1898. Both the lower and upper courts decided that the Elmore patent of 1898 was valid, but the process of the Minerals Separation company did not infringe it. The decision turned principally on the point that the Elmore process was limited to the use of heavy oil, while the Minerals Separation company used a thin oil.

As regards Elmore's patent of 1901 the lower court decided that it was not valid and consequently the question whether the Minerals Separation process was an infringement or not, did not arise. But in the Court of Appeal, the judgment was that Elmore's process of 1901 was valid and that the Minerals Separation process was an infringement. To upset the validity of the 1901 patent, the defendants brought forward the specification of Everson's American patent of 1886, and the specification of an English patent granted to Joseph William Sutton in 1892. The court decided that there was nothing in the Sutton specification which was remotely relevant. As regards Everson's specification, the court decided that it was entirely different from the Elmore process. In the Everson process the ore and oil, with or without an acid or neutral salt, are mixed into a stiff mass and the gangue is then washed out. In Elmore's patent there must be a flowing pulp of ore and water. This feature is vital. The result of the appeal is therefore that the Elmore patent of 1901 is held valid and that the Minerals Separation process, which employs thin oils and acid and is considered to be substantially the same process as Elmore's, is held to be an infringement.

West African Mines—Much interest has been aroused in the announcement made during the week that the Consolidated Goldfields of South Africa, Ltd., had decided to invest a large sum of money in West Africa. Arrangements have been made for providing the Effuenta (Wassau) Mines, Ltd., the Fanti Mines, Ltd., and the Wassau West Amalgamated mines with working capital. These mines are situated in the Tarkwa district and own a large stretch of outcrop of the banket reef, and are neighbors of the Tarkwa, Abosso and Abbontiakoon Block 1 mines, which are producing gold on a large scale. A reduction in working costs has taken place in the last year or two and further reductions are anticipated.

It is no doubt on the strength of the improved position of the existing mines that the Consolidated Goldfields are taking a large interest in properties as yet only developed on a small scale. The goldfield has up to the present given disappointing results. There is a large output of gold, amounting last year to over £1,000,000; but owing to the heavy expenditure, caused by the unhealthiness of the climate, the profits are small. The goldfield has no doubt great possibilities and if the expectations of reduced costs, which some engineers claim can be made, are realized, more prosperous times for shareholders in Gold Coast mines may be seen.

Tanganyika Concessions—The report of the Tanganyika Concessions, Ltd., for the year ending June 30, 1908, has been issued. A provisional arrangement has been made for the construction of a railway to connect the Rhodesian railway system, which has now reached Broken Hill, with the Star of the Congo in the Congo State. Ultimately the railway is to be continued to the Ruwe mine and linked up with the Benguella Railway, thus affording access to the west coast.

For the near future the outlet for the copper of the Congo will be through Rhodesia at Beira on the east coast. At the Kansanshi mine in northwestern Rhodesia a furnace is smelting about 500 tons of ore a month, yielding an output of about 90 tons of copper in the form of ingots. It is proposed to send out a larger furnace to treat at least 1250 tons of ore per month, which will give an output of from 200 to 250 tons of copper. Allan Gibb, the engineer of the company, writes that under present conditions the cost of producing copper is £16 per ton. With the proposed new plant, the cost of producing copper will be £12 10s. per ton. Smelting commenced in April and up to September 500 tons of copper have been produced.

At the Kambove and Star of the Congo mines, situated in Belgian territory, large quantities of copper ore are said to be available for mining, and the installation of a smelting plant is being considered. Transport is at present the main difficulty.

A consignment of 50 tons of copper was brought by wagon from Katanga to Benguella, while transport between Kansanshi and the end of the railroad at Broken Hill is being carried out by traction engines.

The Tanganyika company has purchased a coal property, plans of which are attached to the report, from the Zambesia Exploring Company.

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

GILA COUNTY

Miami—Drifts on the 570-ft. level have again run into high-grade ore. This accounts for the recent rise in the stock.

Old Dominion—The plant made a record production of copper during December. The full battery of six furnaces has been in operation part of the time, turning out copper at the rate of about 4,000,000 lb. per month. One of these furnaces is shut down at present undergoing repairs, but it will be put in operation again in a short time. It is believed that the Old Dominion will produce for the year 1908 not less than 38,000,000 lb. of blister copper.

Eureka—H. B. Howland and Hoval A. Smith and associates have taken over this group of claims owned by D. D. Sullivan, of Globe, J. Warren Young, of Chihuahua, and Frank Tabinski and Patrick D. Sullivan, of Calumet, Mich. The property is seven miles southwest of Globe, and consists of 10 claims. The consideration is $300,000.

California

AMADOR COUNTY

Amador Queen—George Hambrick and associate leasers have shipped a quantity of rich ore to the smelter and have had their leases renewed for two years.

Bunker Hill—This mine has just made its best record for a month—$23,000 for November. An extra dividend has been declared for Christmas. E. H. Harrington is superintendent.

Original Amador—This mine, which has been idle several years, is being opened by a new company.

Treasure—In this mine, Amador City, prospecting operations have reached a depth of 400 ft. under superintendency of L. R. Poundstone. Good milling ore has been found.

BUTTE COUNTY

Mesilla Valley Gold Gravel Mining Company—This new company is to mine on an extensive scale near Pentz on the Magalia ridge. E. C. Wilson, of Pentz, and A. M. Wilson, of Cherokee, are among the incorporators. This was formerly a hydraulic mine, but it is now to be drifted.

CALAVERAS COUNTY

Benson—This quartz mine, near Altaville, after a year's idleness, is being reopened. The property has a 20-stamp mill and 20-drill compressor plant driven by electric power. George Walker is superintendent.

Red Gold—J. Campbell is arranging to reopen this quartz mine at Angels.

EL DORADO COUNTY

California-Manhattan—In this mine, near Nashville, an 8-ft. ledge has been crosscut which carries about $14 per ton. A mill is to be put up on the property.

Independent—Albert Shafsky, of Placerville and Seymour Hill, of El Dorado, in reopening an old prospect near El Dorado, have taken out about $30,000 within 20 ft. of the surface. The vein found is about 8 in. wide.

HUMBOLDT COUNTY

Orleans—At this place, on the Klamath river, Luther Heacock recently made a strike on Ten Eyck creek in a rich seam of rock. At the Harvey & Pierpoint mine, owned by Mr. Head, a mill is now running. The Doney & Little claims are being developed and the mill will soon be started on ore.

INYO COUNTY

Custer—This is the new camp in the Argus range about 14 miles off the line of the new railroad the Southern Pacific is building to Keeler. The Custer Mining Company has 50 claims in the district, and has already built a five-stamp mill.

NEVADA COUNTY

Lion and Torpie & Schroder—H. M. Black, superintendent of the Ironclad mine, has bonded these two claims in Rough and Ready district and will shortly commence work upon them.

Rose Hill—This Grass Valley company is about to install machinery so as to sink 500 ft. on the ledge.

Yuba—At this mine, C. A. Marriner, manager, the 30-stamp mill has been started up.

PLACER COUNTY

Cash Rock Dredge—This dredge has quit work for the season and the divers have been discharged. Many large boulders interfered with the work this year, and they had to be drilled and blasted under water.

Colorado

OURAY COUNTY

Camp Bird, Ltd.—A report from the London office shows that for the quarter ended Oct. 31 last the mill crushed 20,791 tons dry ore. Receipts from bullion sold were $402,330; concentrates, $75,269; total, $477,599. Working expenses of all kinds were $143,139; construction accounts, $9306; London office, $4500; total, $156,945, leaving a balance of $320,654. A dividend of 1s. per share, requiring £41,000, was paid Nov. 7. In the mine development work was 1058 ft.; cubic feet stoped, 158,000. On Oct. 31, the total dry ore broken in the stopes amounted to 79,636 tons.

The report further says: "The general manager, W. J. Cox, at the suggestion of the consulting engineer, John Hays Hammond, came to London to lay before the directors their recommendations regarding the future developments at the mine, advised by the geologist, J. E. Spurr, in his reports on the property. The directors, after careful consideration, have decided to adopt these recommendations, among which, in brief, are: (1) To discontinue developments in depth, and exploit the upper horizon of the Camp Bird vein and other veins on the company's property. (2) To drive a crosscut to the Coronado and other veins from the second level, and drift extensively in both directions on the veins when cut. With this end in view, the manager, on behalf of the company, has acquired the Trilby, Tiptop, Minnie Lee, and claims Nos. 1, 2, 3, 4, and 5, which the directors are pleased to report he has been able to do on very favorable terms."

LAKE COUNTY

Chrysolite—In this mine, Fryer hill, P. McGreevy and associates are leasing several blocks of ground at the 200-ft. level and for some time past have been shipping a good grade of iron, at the same time carrying on development work. In one drift where this work was being done at 180 ft. from the shaft a vein of ore 12 ft. wide was caught and driven for several feet when a streak was noticed in the center of the orebody, samples were taken from it giving high returns in silver and 67 per cent. lead. The find was made in virgin territory, and will no doubt prove to be an extension of one of the shoots that made the mine famous in early days.

Cleveland—In this mine, South Evans

gulch, preparations are now being made to start sinking the shaft another 100 ft., and work will be commenced by the first week in January. When the contract is completed and the drifts to the north and south opened it will give the company sufficient ground to work for another two years. The fissure vein continues to produce some rich gold ore, and it is expected with depth that the ore will carry greater values.

Favorite—In this mine, South Evans gulch, for several days a small streak of ore has been followed at the 175-ft. level.

Michigan

COPPER

Ojibway—No. 2 shaft of this company has reached the third, or 650-ft. level, and a station is being cut preparatory to crosscutting to intercept the lode. No. 1 shaft is down about 630 ft. and will probably strike the lode about the same time as No. 2 owing to the close proximity of the lode to this shaft.

Centennial—No. 1 shaft of this property is sinking below the 34th level and No. 2 shaft is at the 32d. These shafts start 90 ft. apart at the surface and diverge, and at this depth they are about 600 ft. apart. Drifting to the north of No. 1 is opening up some good-looking ground.

Allouez—At No. 1 shaft sinking has been discontinued just above the 13th level. No. 2 shaft is now at the 12th level, and the pitch of the shaft is being changed to conform with the dip of the formation. It is calculated that this shaft will cut the lode in about a month. Drifts from the lower levels of No. 1 shaft to the south are opening a good grade of rock.

North Lake—This company has not yet reached the ledge with the sand pipes that it is sinking preparatory to diamond drilling; the overburden at these points is between 400 and 500 ft. thick.

Lake—The new hoisting engine at this property has gone into commission and a four-ton skip is now doing duty in the shaft. Sinking continues and the shaft is nearing the third level, with the same rich ground in evidence throughout. The new air compressors will, in all probability be ready to do duty as soon as this level is reached and additional drills are added.

Elm River—This company has begun crosscutting toward the east from the bottom of its exploratory shaft, a distance of 200 ft. from surface. The crosscut is being driven to intercept the various formations believed to traverse the tract and can be extended a distance of about 2000 ft. or to the eastern boundary of the property.

Calumet & Hecla—This company has begun the erection of its electrically driven subshaft hoist. This hoist will be placed at the end of a drift from the 57th level of No. 5 shaft and the subshaft will command the ground tributary to the five forties north of the Tamarack, Jr., property. The rock will be hoisted to surface through the Red Jacket shaft..

Missouri

ZINC-LEAD DISTRICT

Church-Mitchell—This mine at Duenweg has resumed operations after being shut down for five months.

Isabel—This mine at Alba lost its mill and most of the machinery by a cave of the workings.

Kalitan—This company has put drill holes to one more novel use in sending timber into the mine through them.

Lehigh Circle—This company has been incorporated with a capital stock of $50,000. The stockholders are F. A. Brown, of Duluth, Minn., and Squires & Strohm, of Joplin. C. F. Strohm, of Joplin, is secretary. The company has a lease on 206 acres of land in Center Creek valley, near Lehigh, on a 10-per cent. royalty.

Mattes Brothers—This company has nearly completed moving the 400-ton San Gabriel mill from Duenweg to its land southwest of Joplin.

Oronogo Circle—This company at Oronogo has installed a dredge boat, equipped with a large centrifugal pump and driven by electric power, to clean out the settling ponds and return the sludge to the mill.

Pinnacle—This company, of Joplin, has leased the Hill Top tract at Oronogo from the Granby company and has let a contract for the erection of a 350-ton mill. J. H. Tonkin, of Joplin, is manager.

Sturgis Mine—This property, adjoining the K. C. Bradford lease at Carterville, has been sold to C. C. Playter, of the United Zinc Company; M. A. Shepard, of Chicago, and G. M. Burke, of the Bull Frog company, Joplin.

Montana

BUTTE DISTRICT

North Butte Extension—John A. Ryan has returned from New York, where he has been in conference with the directors of the new North Butte Extension Development Company. Mr. Ryan now represents both the old and the new company and will have entire charge of operations at the company's properties in Butte. He states that the work of unwatering the shaft will be begun by the first of the year.

JEFFERSON COUNTY

Corbin Copper Company—This company has recently been formed under the laws of Michigan for the purpose of operating a group of 28 claims in the Corbin district. The company has 150,000 shares of capital stock. Of this amount 90,000 were given in exchange for the property and 60,000 placed in the treasury; 25,000 shares of the treasury stock will be sold at $5 per share for development purposes. The property has been developed by tunnels having an aggregate length of 1000 ft. The directors are Stephen R. Dow, Richard M. Edwards, George E. Learnard and N. W. Jordan.

Kelly Smelting and Refining Company—The Alta group, consisting of seven patented claims, will be actively worked by this company which has recently secured control of the claims. The Kelly company has been operating at the Kelly camp in New Mexico, where it owns a number of mines and a smelter. It is stated that two 3-compartment shafts will be sunk and a concentrator erected on the property. The company's directors are L. O. Hedden, S. W. Traylor, Warren Curtis, Marcus Hewett and ex-Governor Hauser, of Montana.

FERGUS COUNTY

Half Moon Pass Mining Company—The company has recently been formed to operate a group of six gold claims situated about 30 miles from Judith. Seven men are now employed at the property under the direction of Thomas Stigen. It is proposed to erect a mill next spring.

CARBON COUNTY

Frank L. Clark, Dr. M. Souders and Louis Chapman have sold 480 acres of coal lands situated in the Bear Creek district to Thomas Ryan, representing Nebraska capitalists. Mr. Ryan has been on the property with a corps of engineers for several months making an examination.

Nevada

ESMERALDA COUNTY—GOLDFIELD

Daisy-Florence—This lease on the Florence operated by Mitchell & Fairfield is sacking high-grade ore. The sacked ore is being stored in the vaults of the Registration Trust Company pending shipment.

Atlanta—The Cherokee lease has installed a hoist; sinking will be resumed as soon as financial arrangements now under way are completed.

Consolidated Mill—The mill bins now contain 4000 tons of low-grade ore ready for the initial run of the stamps which is scheduled for Dec. 26. The entire mill will now be able to operate to full capacity for about 60 days.

Florence Goldfield—In a drift driven from the main company workings to connect with the Engineers Lease shaft on the 500-ft. level an entirely new body of bonanza ore has been found. The extent of this orebody has not been determined.

Kewanas—Two new leases have been let on this claim about 400 ft. from the main workings where the company is doing considerable development work. Block 6 was leased to Elliott & Company, of Chicago, who agree to sink a two-compartment shaft to a depth of at least 500

ft. The lease runs eight months. Block No. 5 was leased to Charles Harrison, of Omaha. No stipulations were made as to depth required; this lease runs 18 months.

Old Kaintuck—The Iconoclast shaft has been retimbered to a depth of 180 ft. When these repairs reach the 200-ft. level, Hardy Brothers, who have leased the property, will start active development work.

C. O. D. Consolidated—The Gold Bar shaft, now 300 ft. deep, shows a wide body of gold-copper ore too low in grade to work at the present price of copper, but sufficiently mineralized to encourage further development.

Smith Florence Mining Company—This company has taken over the old sub-lease let to Mitchell & Fairfield on the Hall-Florence ground. The sub-lease contract called for the sinking of the Hall-Florence shaft from the 300-ft. to the 500-ft. level; this work is now in progress. The Smith block of ground will be entered by a drift only 10 ft. long from the shaft. Both the Smith and the Hall leases will be worked from this shaft.

Booth—The Murphy-Sweeney lease on the Booth has found ore of good shipping grade in a winze sunk from the north drift on the 400-ft. level.

Hazel Goldfield—At this lease on the Last Chance claim of the Laguna, the broken-up orebody, which was found some weeks ago on the 720-ft. level, has been found in place in the southwest drift about 30 ft. from the shaft. A 4-ft. body of ore in the breast of this drift averages $42.50 per ton.

Esmeralda County—Lodi

Illinois Mine—A 100-ton smelter is being installed. All the machinery equipment for the smelter and shops has arrived at Luning on the Southern Pacific and is being hauled 50 miles to Lodi by the company's traction engine.

Esmeralda County—Silver Peak

Silver Peak Valcalda—The 10-stamp mill, now running to full capacity is to be increased to 40 stamps so as to have a capacity of 200 tons per day. M. J. O'Meara is president of the company.

Bay State & Nevada Oil Company—This company, which is drilling for oil near Blair has lost its string of tools at a depth of 517 ft. just subsequent to the securing of the first sample of oil from the hole. Fishing tools have been ordered from Los Angeles.

Goldfield Silver Peak Mining Company—At this property about 25 miles northwest of Goldfield at Coyote Springs in the Silver Peak quadrangle a ten-stamp mill and cyanide equipment is to be built. The property is controlled by the officials of the Clark railroad.

Esmeralda County—Hornsilver

Great Western—At this mine, which has been developing very well as a silver property, a vein of gold ore has opened up on the 300-ft. level. This gold discovery appears to be more important than the silver orebodies discovered in the past. The gasolene traction engine for hauling the ore to Cuprite has arrived.

Humboldt County—Chafey

Black Hole Mine—The new shaft is down to the 105-ft. level where a station will be cut and drifts started on the ore. Sinking will be resumed as soon as possible. The main drift in the upper tunnel after passing through a pinch for 20 ft. has again come into a solid breast of ore. Another Huntington mill is being installed; this will increase the capacity of the mill to 50 tons.

Esmeralda County—Rawhide

Victor—The Victor shaft is 300 ft. deep and is still in good ore. Ten feet of the ore averages $34 per ton.

Rawhide Rector—In the Cooks and Waiters lease a crosscut is being driven to the vein.

Kerns No. 2 Lease—Recently ore has been found on the 200-ft. and 400-ft. levels so that now ore is developed on all the levels of the lease. In the nearby St. Ives lease milling ore has been found.

Hooligan Hill Leases—The Truett and the Miller leases are sacking ore for shipment.

Humboldt County—Seven Troughs

Seven Troughs Mining Company—A test run on ore from this company's mine is being made at the Kindergarten mill to determine the best method for treating the ore. The company plans to build a ten-stamp mill.

Vernon Gold Prize Mining Company—A tunnel has been started on the west side of Gold Prize hill which will be run 250 ft. to prospect the hill.

Wihuja Gold Mines Company—The Wihuja lease on the Therein ground of the Seven Troughs Coalition Company has cut the rich Kindergarten shoot at a depth of 320 ft. in the incline shaft, or at a vertical depth of about 200 ft. This corresponds to the depth in the Kindergarten mine at which this vein has proved rich.

Nye County—Tonopah

Production for the week ending Dec. 12 amounted to 5268 tons, having an estimated value (shipping ore valued at $60 per ton and milling ore at $25 per ton) of $131,700. The Tonopah Mining Company sent to the mill 3000 tons; Belmont, 700; Montana-Tonopah, 593; Midway, 100; MacNamara, 375; West End, 150; Jim Butler, 350 tons.

Tonopah Mining Company—An advance of 10 ft. was made during the week in the Mizpah shaft, the total depth now being 1274 ft. The flow of water recently struck, and which was the first water found in the Tonopah mines, has impeded work. The flow has increased now to such volume that all sinking has stopped until pumps can be installed. The drill hole from the 740-ft. level is down 217 ft.; there is a slight change in the rock that the drill is passing through. At the mill at Millers 99 out of the 100 stamps during the week ending Dec. 12 treated 3210 tons of ore having an average value of $23.50 per ton. Shipments consisted of 72 bars of bullion, weighing 77 lb. each, and worth $815 per bar, and 50,000 lb. of concentrates valued at $11,500. The extraction was 88 per cent.

German-American Mining Company—Arrangements are being completed to resume work on this property about a mile northwest of town. A contract has been let for sinking a new shaft at a point where surface indications are most favorable. The old shaft is 680 ft. deep.

Montana-Tonopah—The tonnage produced and milled this week was smaller than usual, due to necessary repairs in the mill. The tonnage treated was 970 tons, 593 tons coming from the company's mine and the rest from the MacNamara.

West End—Much development work is being done on the 200-ft. and 400-ft. levels. Quartz is being found in many different places; not all of this is rich enough to mine, but streaks of pay ore and large bunches of milling ore are being found.

Nye County—Helena

Broken Hills—Tests are now being made in Denver on the ore so as to determine the process to be used in the 50-ton mill which the company intends to erect. J. C. McCormack, of Goldfield, is president and general manager.

Nye County—Bullfrog

Mayflower—Grab samples of the ore in the cars coming from the two raises on the 300-ft. level assay $52.60 per ton. Similar samples of the ore coming from a length of 150 ft. along the main drift on the 300-ft. level average $15.25 per ton.

Churchill County—Wonder

Jack Pot Consolidated—The Jack Pot management assures the mine owners of the camp that they will put up a custom mill, and have asked for data that will enable them to decide the question of capacity.

White Pine County

Giroux—The smelter burned Dec. 18. It had never been in operation.

New Mexico

GRANT COUNTY—SYLVANITE

Americus-Sylvanite Mines Company—This company has been organized to work three claims adjoining the Nederland property. The officers of the company are F. R. Berbower, of Cripple Creek, president; A. F. Hartman, of Sylvanite, vice-president and manager; M. E. O'Brien, of Cripple Creek, secretary and treasurer, and James F. Gray and E. J. Carlin, of Denver, are on the board of directors.

Sylvanite Consolidated Mining Company—This company has been organized to operate the eight claims known as the Holcomb property, southeast of Sylvanite. E. A. Wheeler and Milton Ish, of Goldfield, Nev., control the company. The stock of the new company will be placed on the market at once. It has four open cuts on its Clemmie claim from which rich ore is being sacked, and on which a two-compartment shaft was started this week. This property has the most extensive showing of any in the district. The vein from 10 to 30 ft. wide extends the full length of the property and can be traced to the Broken Jug and the Big John claims. The latter claim is being developed by the King Solomon Mining Company, which is sinking a shaft and driving two tunnels on its two claims. The work is in direct charge of Leonard Loehr, of Bisbee, manager of the company.

Wood Mine—The Pierson brothers, of Ouray, Colo., and W. E. Irwin, of Bisbee, Ariz., the new owners of the Wood mine, have closed a contract for hauling the ore from the mine to Hachita. From there the ore will be shipped to the smelters at Douglas. The whole breast of the tunnel, now 300 ft. long, is in ore.

Pennsylvania

ANTHRACITE COAL

Hillside Coal and Iron Company—The fire which destroyed the carpenter, blacksmith and machine shops at the Butler colliery Dec. 24 is a severe blow to the company, although the loss is partly covered by insurance. The building was a large wooden structure, complete in every detail and equipped with the latest machines and tools, the company having recently installed a large lathe and several other small machines in the machine shop in order to do the machine work at the colliery instead of sending it to local shops. The carpenter shop was connected with the blacksmith shop, and in it was done the work of repairing and rebuilding mine cars. All the tools belonging to the workmen were destroyed or ruined by the fire, besides many tools belonging to the company.

BITUMINOUS COAL

John W. Boileau, representing a Pittsburg syndicate, has bought a tract of 6000 acres of coal land in Greene county, at a price said to be $250 per acre. The tract included in this purchase is in what is known as the North Waynesburg field, in Morris, Washington and Franklin townships, to the northeast of Waynesburg and along the Waynesburg & Washington railroad, the center of the tract being in the vicinity of Sycamore station. Geologically, the tract lies in what is known as the Waynesburg syncline, similarly located to that of the Pittsburg & Westmoreland Coal Company to the north, and adjoining the holdings of Frank M. Osborne & Co., and on the west of the tract lately purchased by the Emerald Coal Company. It is the last large tract available in this field.

South Dakota

CUSTER COUNTY

Ruberta—Superintendent W. W. Olds, of Custer, is employing a good force of men in sinking the two shafts west of Custer. One is down 180 ft. and the other 100 ft. and some ore showing has been made. The stamp mill is to have an addition of five stamps before spring.

LAWRENCE COUNTY

Branch Mint Operating Company—The 800-ton mill is making test runs of mine and dump ores, and if results are satisfactory, will be run steadily. President John Ohmeis, of New York City, is expected here shortly.

Homestake—The Pocahontas mill has just changed its equipment and is now operated with electricity instead of steam. The other mills will soon be under the same motive power. Sinking in the Ellison shaft, the deepest in the Black hills, will probably soon be commenced again. It is now down 1750 and is to be deepened 150 ft. more.

Queen Esther—The shaft is now down 60 ft. and will be sunk to quartzite by Stewart Conners and associates of Deadwood. A good mineralization is showing in the present formations.

Tinton—The mill has closed for the winter, after a successful run. Superintendent E. W. Noakes, of Chicago, announces that a plant will be built in the spring.

Victoria Extension—New officers were elected at the annual meeting as follows: President, J. C. Carson, Deadwood; vice-president, W. M. Glass, Omaha; secretary and treasurer, A. J. Maltener, Deadwood; directors, A. B. Smith and T. L. Kounts, Omaha.

Victoria—It was decided at the annual meeting held here recently to start up the 200-ton cyanide mill again on a test run under the management of O. N. Brown. The ore reserves that show plenty of good-grade cyaniding ore will be sampled thoroughly and if practical, the mill will be kept in steady operation. The new officers elected are: President, A. B. Smith; vice-president, Arthur C. Smith, Omaha; managing director, W. M. Glass, Omaha; secretary, treasurer and general manager, A. J. Maltener, Deadwood.

PENNINGTON COUNTY

Pilcher—Charles and Joseph Pilcher have discovered a ledge of free-milling gold ore near Rochford, and are preparing to develop it.

Utah

BEAVER COUNTY

Cedar Consolidated Mines Company—This company has been formed by the consolidation of the Cedar and the Talisman companies.

North American—The new shaft being sunk by contractors is now 100 ft. deep.

SALT LAKE COUNTY—ALTA

South Columbus Consolidated—Some time ago No. 1 drift east from the adit struck a broken-up body of copper ore. A raise driven from the adit has found this orebody in place. The vein is from 2½ to 3½ ft. wide and rich in copper. A winze has been started from the adit to catch this vein.

Columbus Consolidated—A body of good ore 4 to 10 ft. wide has been developed on the 400-ft. level for a distance of 80 ft. A raise has been started from that level to develop this orebody.

SUMMIT COUNTY

Shipments—Shipments from the Park City mines during the week ending Dec. 19 amounted to 1812 tons. The Silver King shipped 825 tons; Daly-West, 575; Daly-Judge, 304; American Flag, 109 tons.

Ontario Tunnel—There has been an increased flow of water coming through this tunnel the last few weeks. Evidently this is coming from the Daly-West mine, for the water in the Daly-West shaft is being lowered. The water course was struck in Ontario ground. The tunnel has been turned so as to follow this fracture which leads toward the Daly-West shaft.

TOOELE COUNTY—TINTIC

Shipments—The Tintic mines shipped 131 cars of ore during the week ending Dec. 18. The Sioux Consolidated shipped 14 cars; Iron Blossom, 4; Colorado, 16; Dragon Iron, 19; Black Jack, 1; Brooklyn, 3; Lower Mammoth, 3; Ajax, 3; Swansea, 2; Eureka Hill, 1; May Day, 1; Centennial Eureka, 44; Bullion Beck, 1; Yankee, 2; Uncle Sam, 6; East Tintic Development Company, 1; Utah Consolidated (leasers), 1; Grand Central, 9 cars. The cars from the Colorado, Dragon Iron, Brooklyn and Swansea mines were 20-ton cars, the rest 30-ton cars.

West Tintic—This mine belonging to the Nevada-Utah Development Company and in the West Tintic district made its first shipment last week. About 25 men are working at the mine.

Centennial Eureka—A sinking pump has been ordered to handle the water cut in the main shaft at a depth of 2100 ft. The shaft is making about 60 gal. of water an hour. Apparently this is a surface flow of water.

Opohonga Mining Company—This company has arranged to develop its property through the shaft workings of the Black Jack company. The 300-ft. and 1000-ft. levels of the Black Jack will be extended into Opohonga ground.

Iron Blosson—Copper ore has been found on the 800-ft. level.

TOOELE COUNTY—OPHIR

Lyon Hill Consolidated Mining Company—The first shipment from the orebody recently found in the adit assayed 255 oz. silver, 0.06 oz. gold and 7 per cent. lead per ton. In the winze below the adit the orebody is 14 ft. wide. The high-grade streak is in the center of the vein.

Ophir Hill and Cliff Mines—Twenty-five teams are hauling ore from the Ophir Hill mine, belonging to W. A. Clark, of Montana, and 20 teams from the Cliff property.

Canada

Arrangements have been entered into between the Ontario government, the town of Sudbury, and Mackenzie & Mann, of the Canadian Northern Railway, by which Mackenzie & Mann undertake the construction of a wagon road between Sudbury and Gowganda, a distance of 80 miles. A gang of men has been started on the work. Mackenzie & Mann are also surveying the country with a view to extending the Canadian Northern Ontario Railway into the Gowganda district.

Alfred von Hammerstein, who has been carrying on extensive petroleum development in northern Alberta, calls attention to the enormous waste of natural gas which has been going on for many years in that region. Fifteen years ago when drilling for oil was undertaken by the Canadian government at Pelican Portage on the Athabasca river, a tremendous flow of gas was struck at a depth of 800 ft., which made it impossible to proceed with operations; the flow has continued ever since, the government, in spite of the representations of those interested in the development of the district, having done nothing to stop it. An extended area is being drained.

ONTARIO—COBALT DISTRICT

Ore Shipments—Shipments of ore for the week ending Dec. 19 were as follows: Buffalo, 54,980 lb.; Crown Reserve, 120,000; City of Cobalt, 60,000; La Rose, 195,000; McKinley-Darragh, 115,800; Nipissing, 130,760; Right of Way, 62,100; Silver Queen, 67,000; Silver Cliff, 44,000; Temiskaming, 60,000; Trethewey, 131,000; total, 1,040,640 pounds.

Cobalt Central—The company is enlarging the capacity of its concentrating mill, and will soon begin the treatment of custom ores, having already made some contracts with neighboring mines.

La Rose—A rich vein recently struck on the O'Brien property runs into La Rose ground parallel to No. 3 vein; it will be worked from No. 3 shaft. No. 3 vein has widened at the bottom of the shaft to 4 in., and is yielding 5000 oz. of silver to the ton. At the University mine the shaft on No. 4 vein is down 50 ft. with ore showing all the way averaging 3000 oz. to the ton.

Nipissing—A new vein has been encountered in crosscutting at the 75-ft. level from the Fourth of July shaft; it is thought to be vein No. 100; it is 3 in. wide and carries high-grade ore. The shaft is being sunk to the 150-ft. level. The new ore house at this shaft is completed. At the 75-ft. level of the Meyer shaft the vein, averaging 5 in. wide, has been drifted on for 150 ft., and is yielding well. No. 6 shaft, near the Temiskaming & Hudson Bay boundary, is down 75 on a wide calcite vein. In drifting 300 ft. east of the Kendall shaft at the 145-ft. level a new cross-vein, carrying between 3 and 8 in. of good ore was struck. A quarterly dividend of 3 per cent. with a bonus of 2 per cent. has been declared, payable Jan. 20, 1909.

ONTARIO—LARDER LAKE DISTRICT

Dr Reddick—The closing down of the stamp mill was caused by a bad break in the Gates ore crusher, weighing between three and four tons. Owing to transportation difficulties, some time will elapse before the crusher can be put in working order.

ONTARIO—WELLAND COUNTY

Coniagas Smeltery—About two tons of silver, the output of this smeltery at Thorold, were shipped to New York this week.

Big Six—Six veins have been found, two of which look promising. The main shaft is down 50 ft. on an 8-in. calcite vein, assaying 700 to 800 oz. silver to the ton. A 6-in. cobalt vein carries argentite and native silver.

ONTARIO—SOUTH LORRAINE DISTRICT

Jacobs Exploration Company—On the Wiltsey property, owned by this company, a 3-in. smaltite vein carrying native silver has been found, and ore is being taken from a test pit.

ONTARIO—GOWGANDA LAKE DISTRICT

McIntosh and McLaughlin Location—F. A. McIntosh and Samuel C. McLaughlin have disposed of their claim, said to be a rich one, to a syndicate of British and American capitalists; the price is reported to be about $500,000. The property will be known as the Bartlett mine.

NOVA SCOTIA

Nova Scotia Steel and Coal Company—The output of coal for the 10 months ending November was 601,294 tons, as compared with 575,693 tons for the corresponding 10 months of 1907.

Mexico

GUANAJUATO

Shipments—The value of the shipments for the week ending Dec. 17 amounted to $290,000 including concentrates, bullion and high-grade ore. Bullion shipments amounted to $180,000. The closing of the mill announced last week will make little difference in the total production; the loss will be made up by the increased output of the Perigrina mine.

El Cubo—The tunnel driven to tap the Villalpando shaft has been completed. The tunnel which is 7000 ft. long was started from both ends; it will be used to facilitate handling the ore and the water from the lower levels.

Tepeyac Incline—The double-track surface incline from the patio of this mine of the Guanajuato Reduction and Mines Company has been completed. It will carry the ore from the San Antonio dump to the head of the aërial tramway which will deliver it to the Bustos mill.

Providencia—The foundations for the mill are nearly completed and plans for the equipment are practically finished. The plans call for stamps weighing 1350 lb. There will be 40 stamps, three tube mills, concentrating tables and a cyanide department. Work will be started shortly after the first of the year and rushed to an early completion, in order to handle the ore that is being taken out.

TEPIC

Guanajuatillo—A hydroelectric power plant will be installed to unwater this old mine of the Castellana group which has been abandoned for 100 years.

SONORA

Greene-Cananea—The fifth and sixth furnaces were blown in last week. Not an extra man was required in the operating of the ore-handling machinery. The only increase was a few men to attend each furnace. The contributing factors to the increased output following the blowing in of the two stacks are the Capote, Oversight, Cananea-Duluth and Cananea Central. The Capote output is a sulphide ore, while in the upper levels of the Oversight there have recently been made available large orebodies of higher than average grade. The Cananea-Duluth is now opened for supplying 500 tons daily for a period of five years. The company is treating 3000 tons of ore daily, from which the gold and silver recovery are equal to 1½c. per lb. of copper produced.

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, Dec. 30—The coal trade in the West improves slowly, if at all, and the closing week of the year brings reports of only moderate activity. Continued mild weather keeps down domestic demand, and the call for steam coal is not large. Operators hope that cold weather and the opening of the new year will bring more orders.

The Seaboard bituminous trade is also quiet, and business is only of a moderate character. The steam-coal demand is not improving, but some of the dullness reported is due to the holidays.

Anthracite continues to be a weather market mainly, and not much improvement can be expected until colder weather sets in throughout the East.

Discrimination in Anthracite Rates—M. J. Healey, of Wilkes-Barre, Penn., this week was successful in his contention before the Interstate Commerce Commission that the Lehigh Valley Railroad Company had discriminated against him in rates in the haulage of coal from the Miner's Mills colliery, of which he has the management. Healey had two complaints against this corporation, one as the result of the business done at Miner's Mills and the other in the alleged unfair treatment of the Reliance Coal Company at Pittston, a concern of which he has control. It was on the first grievance the commission heard testimony. The latter one will be gone into later. The argument of the Plains operator was so well substantiated that the attorneys representing the company decided to settle and thus save themselves from the punishment provided for rate discrimination. As a result the Miner's Mills Coal Company will be reimbursed for the excess in rates which has been paid during the entire time in which it shipped coal, a period of four years. The outcome of the protest of Healey is the first instance in which an individual anthracite-coal operator has carried his objections to a successful issue.

Coal Traffic Notes

Tonnage originating on Pennsylvania lines east of Pittsburg and Erie, year to Dec. 19, in short tons.

	1907.	1908.	Changes.
Anthracite.....	5,543,327	5,047,146	D. 496,181
Bituminous.....	38,907,473	33,153,039	D. 5,754,434
Coke.....	12,932,012	7,006,528	D. 5,925,484
Total.....	57,382,812	45,206,713	D. 12,176,099

The total decrease this year to date was 21.2 per cent.

The total coal passing through the Sault canals up to the final close of the season was, in short tons:

	1907.	1908.	Changes.
Anthracite.....	1,506,668	1,384,743	D. 121,925
Bituminous....	9,893,427	8,517,717	D. 1,375,710
Total.....	11,400,095	9,902,460	D. 1,497,635

Coal receipts at Milwaukee by Lake for the season were: Anthracite, 1,076,812 tons, an increase of 194,943 tons; bituminous, 2,584,355 tons, a decrease of 642,696 tons; total, 3,661,167 tons, a decrease of 447,753 tons.

Coal receipts at St. Louis, 10 months ended Oct. 31 were 6,597,393 tons in 1907, and 5,618,083 in 1908; a decrease of 979,310 tons.

Coal shipments by water from Seattle and Tacoma, Wash., 10 months ended Oct. 31, were 502,907 short tons in 1907, and 350,945 in 1908; a decrease of 151,962 tons. Nearly all these shipments are coastwise, to California and Alaska ports.

Coastwise coal shipments from Atlantic ports, 10 months ended Oct. 31, long tons:

	Anthracite.	Bitum.	Total.	PerCt.
New York....	12,368,886	8,361,263	20,730,149	62.4
Philadelphia	1,756,989	3,886,655	5,643,644	17.0
Baltimore....	203,046	3,032,942	3,235,988	9.7
Newp't News	.....	2,259,934	2,259,934	6.8
Norfolk.....	.....	1,374,701	1,374,701	4.1
Total.....	14,328,921	18,915,495	33,244,416	100.0
Total, 1907.	16,031,621	20,419,383	36,451,004	.....

Total decrease this year was 3,206,588 tons, or 8.8 per cent. New York includes all the New York harbor shipping ports.

New York

Anthracite

Dec. 30—The hard-coal market is lifeless, and little business is being done either in prepared or small steam sizes. Schedule prices are $4.75 for broken, and $5 for egg, stove and chestnut. Small steam prices are: Pea, $3.25@3.50; buckwheat No. 1, $2.35@2.50; buckwheat No. 2 or rice, $1.60@2; barley, $1.35@1.50. All prices are f.o.b. New York harbor points.

Bituminous

The soft-coal trade, as a whole, continues dull. The all-rail trade is a little more active than tidewater, and along the Sound more coal is being taken than in the far East. New York harbor is at a standstill.

Consumers are holding off until after Jan. 1, or, if they agree to take coal, they ask that part of the consignment be billed against the new year. Transportation is good and cars are plentiful. Prices in New York harbor remain at $2.45@2.65 per ton.

In the Coastwise vessel trade vessels are scarce, but the demand is light. Freight rates are slightly firmer as follows, from Philadelphia: To Boston and Portland, 75c.; Salem, Lynn and Bath, 85c.; Newburyport, 95c.; Portsmouth, 80c.; Providence, New Bedford and the Sound, 65@70c. per ton.

Birmingham

Dec. 28—The coal operations throughout Alabama will resume on a firm basis next week. It is understood that there will be a resumption at several of the mines which have been idle for some time, while mines which have been in operation will add to their force of employees. Miners are looking forward to the coming month for steady work. Sales agents report that there has been a good inquiry for coal and that orders are in hand or promised that will keep the mines going through the better part of the coming year.

Coke is still in strong demand and the production is being kept at a high mark.

Chicago

Dec. 28—Mild weather and partial suspension of steam needs because of the holidays have made demand for steam coals light in the last week, but shipments to this market have also been light on account of closing of the mines for Christmas and there is little trouble about oversupply. Domestic coals are in general lagging because of the weather. Steam coals show increased demand from week to week and Illinois coals are stronger than for several weeks.

Lump and egg from Illinois and Indiana mines sell for $1.80@2.60; run-of-mine brings $1.65@1.75 and screenings are in good demand at $1.20@1.50. Fine coals are exceptionally strong.

Of coals from east of Indiana, smokeless is weakest, receipts being large and sales lagging. Pocahontas and New River smokeless bring $3.80@4.05 for lump, and $3.05@3.15 for run-of-mine. Lower-grade smokeless is abundant at as low as $3.15 for lump and $2.75 for run-of-mine. Hocking has been overabundant, but is firmer in tone with the surplus well disposed of, and holds well above the $3 mark, though selling last week for 10 or 15c. less. Youghiogheny is quiet at $3.15 for ¾-in. gas.

Anthracite is in plentiful supply and light demand and all sizes are in good supply.

Cleveland

Dec. 29—Business looks a little better, owing to some improvement in purchases of steam coal. The demand for slack just now is better than that for lump and screened coal. Prices for slack are, therefore, relatively higher. Pittsburg No. 8 and Middle District slack bring 70@75c. at mine; Massillon slack, 60@65c. at mine. Domestic coals are quiet, with light demand. Massillon lump is $3.10@3.15, Cleveland.

Pittsburg

Dec. 29—Holiday stops and other conditions have combined to make a very dull market for the close of the year. It is difficult to make an estimate of the conditions at the mines, owing to the cutting out of several working days. Prices are nominally maintained at $1.15 for run-of-mine coal at mine; but sales have been small. The best demand has been for slack.

Connellsville Coke—No change in coke conditions can be reported, as consumers still hesitate about placing contracts for 1909. Present indications, however, are that they will not gain anything by holding back, as prices likely will not decline. Furnace coke for first-half delivery is quoted at $2; foundry at $2.25@2.40, f.o.b. ovens. For spot shipment these prices may be shaded a little, though the disposition to shade is gradually disappearing. Production is increasing; the *Courier* reports this week 251,903 tons, the highest weekly report for the year. The total, by these reports, for the year to Dec. 19 was 9,117,898 tons. To the corresponding date in 1907 the total was 19,155,971 tons, the decrease this year being 10,038,073 tons, or 52.4 per cent. Production is better now than last December, however, this week showing an increase of 113,651 tons over the corresponding week in 1907. Shipments for the week were 9305 cars, divided as follows: To Pittsburg district, 3310; to points west of Pittsburg, 5248; to points east of Connellsville, 747 cars.

Foreign Coal Trade

Belgian Coal Trade—Imports and exports of fuel in Belgium, 11 months ended Nov. 30, metric tons:

	Imports.	Exports.	Excess.
Coal	4,884,110	4,356,999	Imp. 527,111
Coke	267,335	835,713	Exp. 568,378
Briquets	167,010	448,486	Exp. 281,476
Total	5,318,455	5,641,198	Exp. 322,743
Total, 1907	5,296,712	5,542,721	Exp. 246,009

Imports are chiefly from Germany and Great Britain; exports principally to France and Luxemburg.

French Coal Trade—Imports and exports of fuel in France, 10 months ended Oct. 31, metric tons:

	Imports.	Exports.	Excess.
Coal	12,242,100	894,210	Imp. 11,347,890
Coke	1,520,180	114,020	Imp. 1,406,160
Briquets	875,660	108,210	Imp. 767,450
Total	14,637,940	1,116,440	Imp. 13,521,500
Total, 1907	14,518,570	1,191,100	Imp. 13,327,470

Included in the exports this year are 134,260 tons of coal and briquets furnished to steamships in foreign trade.

Nova Scotia Coal—Shipments of Nova Scotia coal for the 11 months ended Nov. 30 are reported as follows, in long tons:

Company:	1907.	1908.	Changes.
Dominion	3,018,155	3,049,104	I. 30,949
Nova Scotia Steel	575,693	601,294	I. 25,601
Cumberland	242,150	332,225	I. 90,075
Acadia	294,557	294,403	D. 154
Inverness	221,104	240,871	I. 19,767
Intercolonial	251,823	226,067	D. 25,756
Total	4,603,482	4,743,964	I. 140,482

One company showed a decrease and one was about stationary. The total increase was 3.1 per cent.

German Coal Trade—Imports and exports of fuel in Germany, 10 months ended Oct. 30, metric tons:

Imports:	1907.	1908.	Changes.
Coal	11,358,689	9,765,314	D. 1,593,375
Brown coal	7,422,418	7,157,580	D. 264,838
Total coal	18,781,107	16,922,894	D. 1,858,213
Coke	346,946	360,756	I. 13,810
Briquets	154,992	155,981	I. 989
Exports:			
Coal	16,457,105	17,442,980	I. 985,875
Brown coal	17,334	22,600	I. 5,266
Total coal	16,474,439	17,465,580	I. 991,141
Coke	3,137,723	3,011,127	D. 126,596
Briquets	1,006,932	1,258,570	I. 251,638

Exports this year include 23,775 tons coke to the United States.

Welsh Coal Prices—Messrs. Hull, Blyth & Co., London and Cardiff, report prices as follows on Dec. 19: Best Welsh steam, $3.48; seconds, $3.36; thirds, $3.24; dry coals, $3.60; best Monmouthshire, $3.18; seconds, $3.06; best small steam, $2.04; seconds, $1.74. All per long ton, f.o.b. shipping port.

Iron Trade Review

New York, Dec. 30—The volume of business transacted has continued light, even less than last week. This is due in large part to the holiday season, when there is always a lull in trade. It is to be observed, however, that specifications on contracts are coming in slowly, which is not a good sign. Business also has been affected by the tariff discussion, and the general belief that the iron and steel schedules will be revised, if there is any change at all. The impression is that Congress will feel compelled to do something to satisfy popular demand for revision. The discussions before the Ways and Means Committee have undoubtedly given an impetus to this feeling.

Pig-iron orders have been few this week and generally small. Foundries have been buying only for immediate needs, and seem to be in no hurry to provide for the future. There is a little more call for basic iron, but it is hardly to be called active. Southern furnaces seem to be better provided with orders than Northern; at any rate they are not hunting for business.

In finished material orders and specifications are both slow. There is talk of contracts, but actual sales are put off to next month. This is the result of the holiday season, probably, and so only a passing condition. There is reason to believe that structural material will soon make a better showing, especially if there is no attempt made to advance prices, or to enforce nominal quotations. Contrary to general belief, it is probable that the amount of structural business in 1908 will make a good showing, compared with the previous year. This cannot be said of any other branch of the iron and steel trade.

Other railroads are slow in following the example of the Pennsylvania, and no considerable orders for rails have been placed. Several roads are said to be figuring on large orders, but they are not yet ready. In view of the comparatively light repairs and renewals made in 1908, it is evident that a large tonnage for 1909 will be needed.

Lake Superior Iron Ore—The *Marine Review*, of Cleveland, reports that the final shipment of ore for the season of 1908 was taken by the steamer "W. D. Rees" from Escanaba to Milwaukee, consisting of 5349 tons. December shipments were therefore 78,924 tons. Shipments for the past three years by ports have been as follows:

Port.	1906.	1907.	1908.
Escanaba	5,851,050	5,761,988	3,351,502
Marquette	2,791,033	3,013,826	1,487,487
Ashland	3,388,112	3,437,672	2,513,670
Superior	6,083,057	7,440,386	3,564,030
Duluth	11,220,218	13,445,977	8,808,168
Two Harbors	8,180,125	8,188,906	5,702,237
Total	37,513,595	41,288,755	25,427,094

The season of 1908 shows a decrease of 15,861,661 tons, or 38.4 per cent., as compared with 1907; and a decrease of 12,086,501 tons, or 32.2 per cent., as compared with 1906.

Baltimore

Dec. 29—Exports for the week included 2,747,500 lb. steel billets to Liverpool; 429,129 lb. structural steel and 2,288,165 lb. steel plates to Panama; 287,360 lb. spelter to Liverpool. Imports included 420 tons ferromanganese from Germany, and 4950 tons iron ore from Cuba.

Birmingham

Dec. 28—Southern pig-iron manufacturers look for a decided change again in the general conditions, both as to buying and as to quotations before the middle of January. There is some inquiry for iron for future delivery, but the holiday quietness has been on for three or four days. However, there is a good feeling prevailing; the order books are supplied for the

coming three months and some sales have already been booked for the second quarter. A few lots of iron were sold before the quietness set in at prices above $13 per ton, No. 2 foundry. The make during the holiday season in the Birmingham district was not disturbed. The furnace records were maintained, and only for a day or two did the common labor appear to be restless. Pay days were arranged with the labor at the ore mines, coke ovens, limestone quarters and at the furnaces so that there would be no trouble in providing for the usual festivities of this season. The Tennessee Coal, Iron and Railroad Company has arranged to blow in its No. 6 furnace at Ensley this week while preparations are being made to start other furnaces in this territory.

Chicago

Dec. 28—Buying of pig iron is very light, the holiday effect being perceptible in every line of business. Inquiries are very few and the small amount of buying being done is on early deliveries. There is said to be no weakening of prices, for the reason that furnace agents as well as users of pig iron are contented to await the developments of the new year. With both sides waiting, the general iron market shows no other signs of weakness, the outlook in finished products being good, though business is dull generally.

Southern No. 2 holds to $13 Birmingham ($17.35 Chicago) as a minimum, and Northern No. 2 to $17, with Lake Superior charcoal selling at $19.50@20, for delivery within the next three months. For the second quarter 25@50c. more is asked, though the lack of any good-sized transactions makes it difficult to say what a good contract could be placed for.

Coke remains weak, being in large supply and poor demand at $4.90 for the best Connellsville.

Philadelphia

Dec. 30—Basic pig iron is in active demand, the largest transaction of the past week being for the delivery of 20,000 tons as called for monthly, the entire delivery to be completed by June 30, if desired. Business into which basic pig enters is improving steadily, and negotiations are pending for additional sales. Forge demand is increasing at central and eastern Pennsylvania mills, but these requirements are filled only as new orders for material come in. Foundrymen have been poor buyers for several weeks, and as furnacemen are not driving after business, sales are moderate and mostly on furnace terms. Southern furnaces are not a threatening factor at present, but when they get hungry for business along in February or March there may be some developments unfavorable to Pennsylvania furnace interests. The volume of business since Oct. 1, when averaged up, shows a steady increase under the policy of buying only what was needed.

Pipes and Tubes—A sharp improvement has taken place in tubes. Boiler-repair work and new boiler work is coming along nicely.

Plates—The favorable conditions in Western mills are reflected in Eastern. The past week has been quiet, but there is a large amount of work in sight.

Structural Material—No large orders have been placed. Several are pending, mostly for bridge and general construction work.

Old Material—In a general way scrap is held too high to induce consumers to buy more than they are obliged to. Dealers are slow to sell, except at their own terms, and they are urgently gathering in all the good qualities they can get, particularly heavy steel scrap. No. 1 yard scrap is held high. There is no railroad scrap offered, and the companies are refusing to sell at present.

Pittsburg

Dec. 29—The iron and steel markets this week have shown little or no change from the previous week. Sales have been light, as might be expected in a holiday week. No estimate can be made of mill operation, as most of the active works were closed down over the Christmas holiday. Some plants closed for the week, but quite a number have stopped until after New Year's, to give them a chance to make necessary repairs. Orders in most of them are not urgent enough to compel an early resumption.

Little news has developed on the rail question. It is understood that several companies are preparing to place rail orders, but none has yet followed the Pennsylvania example, and most of them are still waiting. Several railroad orders for equipment are pending, however, which will require large quantities of material.

Structural business shows no new developments, none of the large contracts pending having been closed this week. New trade continues good, and much activity is expected in January. Tinplate also shows a continuation of the good run of trade recently reported.

Pig Iron—Transactions have been very light, but inquiries are reported to be coming in, so that sellers are inclined to be firm in their views as to price. The starting up of some of the new furnaces at the big Gary plant of the Steel Corporation will not have any effect on the market, as the product will be used by the corporation. Prices show no material change. Quotations for first quarter are as follows: Standard bessemer, $16.50@17; No. 2 foundry, $16@16.25; malleable bessemer and basic, $15.75@16; gray forge, $14.50@15; all f.o.b. Valley furnaces.

Steel—There have been but few transactions in crude steel, and moderate deliveries made on contract. The price of both bessemer and open-hearth billets remains firm at $25, Pittsburg. Tank plate is quoted at 1.60c. and merchant-steel bars at 1.40 cents.

Sheets—The sheet trade continues good for a dull period and prices are strong. Black sheets are quoted at 2.50c. and galvanized sheets at 3.55c. for No. 28 gage.

Ferro-manganese—There is no change in the ferro market and quotations continue around $47 per ton.

Foreign Iron Trade

Belgian Iron Production—Pig-iron production in Belgium in October was 105,060 metric tons; for the 10 months ended Oct. 31 it was 1,185,270 tons in 1907, and 987,570 in 1908; decrease, 197,700 tons.

German Iron Production—The German Iron and Steel Union reports pig-iron production in Germany in November at 930,738 metric tons, being 10,844 tons less than in October. For the 11 months ended Nov. 30 the production was, in metric tons:

	1907.	1908.	Changes.
Foundry iron	2,063,069	2,058,775	D. 4,294
Forge iron.....	717,949	585,537	D. 132,412
Steel pig.....	947,891	836,830	D. 111,061
Bessemer pig.....	432,517	339,295	D. 93,222
Thomas(basic)pig	7,777,959	6,976,548	D. 801,411
Total.....	11,939,385	10,796,985	D. 1,142,400

The total decrease was 9.6 per cent. Steel pig includes spiegeleisen, ferromanganese, ferrosilicon and all similar alloys.

Metal Markets

New York, Dec. 30—The metal markets are still rather quiet as the end of the year is reached. Some speculative activity is manifest, and sales to consumers have been fair.

Gold, Silver and Platinum

UNITED STATES GOLD AND SILVER MOVEMENT

Metal.	Exports.	Imports.	Excess.
Gold:			
Nov. 1908..	$ 2,967,795	$ 2,892,225	Exp. $ 75,570
" 1907..	615,169	63,574,871	Imp. 62,959,702
Year 1908..	73,857,749	45,105,993	Exp. 28,750,846
" 1907..	54,211,240	98,949,557	Imp. 44,738,317
Silver:			
Nov. 1908..	3,951,987	3,275,609	Exp. 676,378
" 1907..	4,187,378	3,602,405	" 584,973
Year 1908..	47,111,382	37,814,676	" 9,296,706
" 1907..	57,212,168	41,690,324	" 15,521,844

Exports of specie from New York, week ended Dec. 26: Gold, $901,010, to Paris and Panama; silver, $684,007, chiefly to London. Imports: Gold, $171,828; silver, $64,099, from Australia, the West Indies and Mexico.

The Bank of France continues to take gold from this country and from the open market in London. Partly this is due to

the prospective placing of a new Russian loan shortly, a considerable part of which will be taken in Paris. The Bank of France in its reserves this week reported $697,678,100 gold and $177,925,925 silver; a total of $875,604,025 specie. The gold held is $159,490,455 more than at the same time last year.

Gold—The open-market price reported for bar gold in London is 77s. 9¾d. per oz.; for American eagles, 76s. 5d. per oz. Most of the gold offered went to France. No more gold is reported taken in New York for export abroad, and none, probably, will be taken until exchange hardens.

Platinum—This has been naturally a quiet week, but the market is strong, and an advance is expected. Dealers quote the same prices, however, as for some weeks past: $24 per oz. for refined platinum, $26.50 for hard, and $20@21 for scrap; in some cases 25c. more.

Our special correspondent reports that in Russia prices are firm, owing to increased demand, especially from abroad. At Ekaterinburg—center of the Ural platinum industry—crude platinum, called in Russia light platinum, and carrying 83 per cent. pure metal, is quoted at 5 rubles 10 kopeks per zolotnik, equivalent to $19.16 per troy ounce. In St. Petersburg the principal dealers are offering considerable quantities of the same grade of metal at 5 rubles 20 kopeks per zolotnik, equivalent to $19.57 per ounce.

Silver—Silver seems to have touched bottom for the present. A more cheerful feeling in India, with buying by the China banks and covering by speculators has taken the edge off the bearish tendency. Advices received here are that the outlook for 1909 is more hopeful than was recently believed.

SILVER AND STERLING EXCHANGE.

December.	24	25	26	28	29	30
New York....	49⅜	.....	49¼	49⅜	49⅜	50⅛
London.....	22⅝	.....	.....	22 1/16	22 1/16	23⅛
Sterling Ex..	4.8700	.....	4.8690	4.8700	4.8665	4.8700

New York quotations, cents per ounce troy, fine silver; London, pence per ounce sterling silver, 0.925 fine.

Shipments of silver from London to the East, year to Dec. 17; reported by Messrs. Pixley & Abell, London:

	1907.	1908.	Changes.
India.....	£10,531,354	£8,412,390	D. £2,118,964
China.....	417,350	641,400	I. 224,050
Straits.....	691,150	164,885	D. 526,265
Total.....	£11,639,854	£9,218,675	D. £2,421,179

Imports for the week £6000 from Mexico, £5000 from the West Indies, £184,000 from New York; total, £195,000. Exports £1500 to Egypt, £35,000 to India; £36,500 in all.

The United States Mint has resumed purchases of silver. On Dec. 23 the treasury Department bought 125,000 oz., 75,000 oz. for delivery at New Orleans and 50,000 oz. at Denver. The price paid was 49.118c. per oz., delivered.

Copper, Tin, Lead and Zinc

Dec.	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.
24	14⅜ @14⅝	14 @14⅛	63¾	29¼	4.12½ @4.15	5.12½ @5.15	4.97½ @5.00
25	.....	.....	....	....	.....	.....	.....
26	14⅜ @14⅝	14 @14⅛	....	29	4.12½ @4.15	5.12½ @5.15	4.97½ @5.00
28	14⅜ @14⅝	14⅛ @14¼	63⅜	29	4.12½ @4.15	5.12½ @5.15	4.97½ @5.00
29	14⅜ @14⅝	14⅛ @14¼	63¾	29	4.12½ @4.15	5.12½ @5.15	4.97½ @5.00
30	14⅜ @14⅝	14⅛ @14¼	63 13/16	29	4.12½ @4.15	5.12½ @5.15	4.97½ @5.00

London quotations are per long ton (2240 lb.) standard copper. The New York quotations for electrolytic copper are for cakes, ingots and wirebars, and represent the bulk of the transactions made with consumers, basis, New York, cash. The price of cathodes is usually 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—A persistent buying movement has developed in the market, resulting in a rather heavy business in electrolytic copper both for domestic and foreign account. As a result, prices have advanced and the close is firm at 14⅜@14⅝c. for Lake copper; 14⅛@14¼c. for electrolytic copper in ingots, cakes and wirebars. The average for casting copper has been 13⅞@14⅛ cents.

Copper sheets, cold-rolled, 20c.; hot-rolled, 19c. per lb. Wire 15¾c. base, carload lots at mill.

The improvement in the London standard market has made further progress and the close is cabled firm at £63 16s. 3d. for spot, £64 12s. 6d. for three months.

Refined and manufactured sorts we quote: English tough, £67; best selected, £66@67; strong sheets, £78@79.

Copper exports from New York and Philadelphia for the week, 5102 long tons. Our special correspondent states exports from Baltimore for the week at 1288 long tons of copper.

Exports of copper in metallic form from the United States for the 10 months ended Oct. 31 were divided as follows, in pounds:

N. American countries	3,430,075
Germany and Holland	282,511,770
Great Britain	106,698,108
France	94,936,974
Other European countries	64,594,885
China	13,735,899
Other countries	2,437,553
Total	568,345,259

Exports of ores and matte were: Canada, 48,802; Mexico, 6209; other countries, 715; total, 55,726 long tons. The renewal of shipments to China is a feature of the present year of which little notice has been taken.

Tin—The market has been in a very unsatisfactory state, and London quotations show rather a disposition to sag. This condition no doubt is brought about by apprehension of an unfavorable statistical position to be exposed at the end of this month. The market closes weak at £131 7s. 6d. for spot, £133 for three months.

Buyers in the domestic market continue to be very reluctant with regard to placing larger orders, and the little business that is being transacted is done at about 28⅞@29 cents.

Lead—Transactions in this metal have been a negligible quantity. Some inquiries are reported for distant delivery, which have not yet developed into actual business. It would, however, indicate that the impression is gaining ground that present prices cannot be far from bottom. The market closes unchanged at 4.12½@4.15c., New York, and 3.97½@4c., St. Louis.

The London market is somewhat lower, but steady at the decline, the close being cabled at £13 for Spanish lead, £13 2s. 6d. for English lead.

Spelter—Consumers have shown little interest in the market during the entire week. On the other hand, there is not much offered for sale on account of orders already booked by the smelters and the high prices for raw material. The market closes unchanged at 5.12½@5.15c., New York, 4.97½@5c., St. Louis.

The London market is firmer at £21 per ton for good ordinaries, £21 5s. for specials.

Base price of sheet zinc is 7c. f.o.b. La Salle-Peru, Ill., less 8 per cent.

Other Metals

Antimony—No sales were made during the week and prices remain unchanged. Quotations are 8.15@8.25c. for Cookson's; 8@8⅛c. for Hallett's and 7⅝@7¾c. for ordinary brands.

Aluminum—Prices continue unchanged. The Aluminum Company of America quotes 24c. per lb. base for No. 1 ingots, and 33@34c. base for sheets. Offers of foreign metal are still made at 22c. Actual sales are reported to be small. The foreign market is still demoralized, with prices low.

Nickel—Large lots, contract business, 40@45c. per lb. On retail business the price ranges from 50c. for 2000-lb. lots up to 55c. for 500-lb. lots. These quotations are for spot nickel. The price for electrolytic is 5c. higher.

Quicksilver—A slight degree of activity has developed during the week, but the market is only moderately active. New York prices are unchanged, at $45@46 per flask of 75 lb. San Francisco quotations are $45 per flask for domestic orders and $43 for export. The London price is steady at £8 10s. per flask, with £8 8s. named by jobbers.

Cadmium—In 100-lb. lots, 75c. per lb., at Cleveland, Ohio.

Magnesium—This metal is offered in New York at $1.25 per lb. in 100-lb. lots. The price is $1.40 per lb. for 5-lb. lots.

Spanish Metal Exports

Exports of metals and ores from Spain, 10 months ended Oct. 31, metric tons, as reported by *Revista Minera*:

Metals:	1907.	1908.	Changes
Copper	7,085	11,744	I. 4,659
Copper precipitate	15,501	16,789	I. 1,288
Zinc	1,294	1,386	I. 92
Lead	158,479	158,000	D. 479
Quicksilver	1,497	1,504	I. 7
Minerals:			
Iron ore	7,444,274	6,339,310	D. 1,104,964
Copper ore	1,022,578	986,714	D. 35,864
Zinc ore	128,994	100,844	D. 28,150
Lead ore	4,742	2,603	D. 2,139
Manganese ore	57,717	18,843	D. 38,874
Pyrites	1,116,462	1,228,576	I. 112,114

Exports of salt, 423,262 tons in 1907, and 495,842 in 1908; increase, 72,580 tons.

Sault Ste. Marie Canal Traffic

The total traffic through the Sault Ste. Marie canals for the season was 58,217,214 short tons of freight in 1907, and 41,390,557 in 1908; a decrease of 16,826,657 tons, or 29 per cent. The number of vessel passages in 1908 was 15,181, showing an average cargo of 2726 tons. The mineral freights included in the totals were as follows, in net tons, excepting salt, which is in barels:

	1907.	1908.	Changes.
Coal	11,400,095	9,902,460	D. 1,497,635
Iron ore	39,594,044	24,650,340	D. 14,943,704
Pig and manuf. iron	307,941	289,308	D. 18,633
Copper	89,959	101,735	I. 11,776
Building stone	898	1,019	I. 121
Salt, bbl	460,802	547,223	I. 86,421

The United States canal was open in 1908, April 27-Dec. 13, inclusive, or 231 days. The Canadian canal was open April 21-Dec. 15, or 239 days. There were no serious blocks or delays during the season.

Lake Freight Rates—The *Marine Review*, of Cleveland, reports the season average of freight rates on coal and iron ore as follows, in cents per ton:

Anthracite:	1906.	1907.	1908.
Lake Erie ports to Chicago	46.20	40.78	40.00
Lake Erie ports to Duluth	35.19	31.26	30.00
Bituminous Coal:			
Lake Erie ports to Chicago	46.05	40.00	40.00
Lake Erie ports to Duluth	34.85	30.00	30.00
Iron Ore:			
Escanaba to Lake Erie ports	60.00	60.00	50.00
Marquette	70.00	70.00	60.00
Duluth	75.55	75.00	65.00

This season there were practically no wild rates, all the business being done on contract.

Zinc and Lead Ore Markets

Platteville, Wis., Dec. 26—The highest price paid for zinc ore this week was $44.50, on a basis of $41@42 per ton of 60 per cent. zinc. For 80 per cent. lead ore $50 per ton was paid.

SHIPMENTS, WEEK ENDED DEC. 26

Camps.	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Platteville	718,670	.....	126,100
Linden	498,430	127,720	.....
Cuba City	357,890	.....	.....
Galena	343,800	.....	.....
Harker	332,340	.....	.....
Highland	261,800	50,000	.....
Strawbridge	238,800	.....	.....
Benton	228,840	.....	.....
Livingston	170,000	.....	.....
Hazel Green	159,800	152,100	.....
Mineral Point	90,000	.....	.....
Days Siding	89,000	.....	.....
Dodgeville	80,000	.....	.....
Elmo	72,770	.....	.....
Total	3,642,140	329,820	126,100
Year to Dec. 26	114,944,360	10,786,340	5,072,604

In addition to the above there was shipped to the Joplin Separator Works, 315,000 lb.; to the Platteville Separating Company, 605,900 lb. zinc ore.

Joplin, Mo., Dec. 26—The highest price paid for zinc ore during 1908 was $47 per ton, two weeks ago. The lowest price of high-grade ore was $36.50 the second week of June, and the average price, all grades, for the year, was $34.34. The highest price of zinc sulphide ore the past week was $45 per ton, on an assay base price ranging from $39 to $42 per ton of 60 per cent. zinc. The highest price for zinc silicate was $23, on an assay base price of $17@18 per ton of 40 per cent. zinc. The average price for the week, all grades, was $38.38 per ton. The highest price paid for lead ore was $50, declining to $48 at the week-end, averaging for the week, all grades, $48.82 per ton.

Christmas observation reduced the output about 30 per cent., and, with an average shipment, the reserve stock was reduced approximately 1300 tons, the first important decrease since the beginning of the heavy purchases. The decrease of the year is 29,417 tons of zinc, at a decrease in value of $3,691,615 and 3701 tons of lead, at a decrease in value of $791,906. The total decrease in value was $4,483,521 for the year.

SHIPMENTS, WEEK ENDED DEC. 26

	Zinc, lb.	Lead, lb.	Value.
Webb City-Carterville	3,152,070	526,180	$75,981
Joplin	2,168,110	216,010	49,630
Galena	947,530	19,830	19,436
Prospertly	501,010	339,780	18,343
Duenweg	614,750	16,340	12,685
Alba-Neck	466,590	15,560	9,712
Aurora	479,100	37,280	9,173
Badger	239,160	.....	7,122
Spurgeon	322,660	57,070	6,517
Granby	550,000	20,000	6,500
Miami	326,070	63,960	6,490
Seneca	.....	240,000	5,948
Carthage	171,630	15,850	3,820
Zincite	167,070	.....	3,341
Sarcoxie	142,040	.....	2,023
Carl Junction	83,440	8,580	1,858
Cave Springs	83,010	.....	1,702
Reeds	63,350	.....	1,267
Totals	10,577,590	1,576,440	$241,498
The year	514,240,350	77,065,510	$10,936,306

Zinc value, the week, $203,002; the year, $8,829,808
Lead value, the week, 38,496; the year, 2,106,498

MONTHLY AVERAGE PRICES

Month.	Zinc Ore. Base Price.		Zinc Ore. All Ores.		Lead Ore. All Ores.	
	1907.	1908.	1907.	1908.	1907.	1908.
January	$46.90	$37.60	$45.84	$35.56	$83.58	$46.88
February	48.30	36.63	47.11	34.92	84.58	49.72
March	49.75	36.19	48.66	34.19	82.75	49.90
April	49.25	35.40	48.24	34.08	79.76	52.47
May	46.90	34.19	45.98	33.39	79.56	56.05
June	47.00	33.06	44.82	32.07	73.66	60.48
July	46.80	34.55	45.79	31.67	58.18	59.90
August	44.56	36.53	43.22	33.42	59.54	60.34
September	41.00	37.63	40.11	34.44	53.52	54.59
October	41.75	35.95	39.83	33.28	51.40	52.63
November	38.60	39.13	35.19	35.02	43.40	54.53
December	31.50	42.75	30.87	39.63	37.71	49.68
Year	$44.36	$36.63	$43.68	$34.31	$68.90	$53.93

NOTE—Under zinc ore the first two columns give base prices for 60 per cent. zinc ore; the second two the average for all ores sold. Lead ore prices are the average for all ores sold.

Chemicals

New York, Dec. 30—The market is steady and trading is quiet. The possible revisions of the tariff tend to restrict business for the time being. On the whole business is up to expectations.

Copper Sulphate—The market is firm and outside dealers are not shading standard prices which are $4.75 per 100 lb. for carloads and up to $5 for smaller lots.

Nitrate of Soda—The market is steady and business is restricted to a small volume. Quotations are unchanged at 2.17½c. per lb. for spot and futures.

Mining Stocks

New York, Dec. 30—The market on the Stock Exchange this week was rather active, considering that it was broken by a double holiday, and that another is coming. At the close the tendency is rather upward, with prices strong, notwithstanding an attempt of some large operators to bring about a general break. A few stocks sold off sharply, but most of the issues largely dealt in held firm.

On the Curb the copper stocks lead in dealing. Some of them advanced, others held their prices and only a few declined. On the whole the market was rather irregular, but with no decided weakness. Such declines as occurred at the close were due to profit taking. The Cobalt stocks were irregular, but showed a good buying demand. The Nevada gold stocks were the weakest of any dealt in. For a holiday week the total volume of business was fair.

Boston, Dec. 29—The market has been on the mend, although the week has included but four days, as the Exchange was closed Christmas and the following Saturday. Prices show a material improvement and considerable activity was generated in spots, particularly in some of the Lake issues. Isle Royale was conspicuous with a $3.62½ advance to $26. Atlantic is up $1.25 to $17.62½; Centennial $1.75 to $33.25; Allouez $1 to $37.50; Franklin $1.75 to $17.50; Mohawk $3.25 to $70.25; Osceola $5.75 to $34.75; Quincy $2 to $95; Tamarack $8.50 to $85; the latter reacting to $82; Wolverine $2 to $152. Copper Range sold up $3.37½ to

$82.50. Two $1 dividends are announced by the Champion, one-half of which is owned by Copper Range and the other half by the St. Mary's Mineral Land Company.

Amalgamated has been in good demand and has risen $4.50 during the week to $84.62½. The declaration of 50c. quarterly dividend by the Anaconda presages the usual Amalgamated dividend next month. Miami has been a feature with an advance from $12.50 to $15.50. Superior Copper has been neglected, compared with late activity, and is off $1.37½ to $34. This stock was bulled pretty hard a few weeks ago. Arizona Commercial rose $2 to $39.50, losing half of it, and Boston Consolidated stiffened $1.37½ to $17.

Announcement is made that a new contract has been made by the Boston Consolidated with the Garfield smelter of the American Smelters' Securities Company. Calumet & Hecla has advanced $15 to $675 and Calumet & Arizona touched $119. North Butte rose $3.37½ to $86; Old Dominion $2.87½ to $58.62½; Parrot $1.25 to $30; Shannon $1.25 to $18. Word comes of the starting of the Balaklala smelter and the renewal of regular Trinity shipments.

United States Smelting has risen $2.25 to $45; and Utah Consolidated $3.37½ to $47. North Lake Mining has been taken from the Curb and put on the unlisted department of the Stock Exchange.

Curb features have been the strength of First National, and the weakness of Consolidated Arizona Smelting.

STOCK QUOTATIONS

NEW YORK	Dec. 29
Name of Comp.	Clg.
Alaska Mine	⅜
Amalgamated	83½
Anaconda	49½
Balaklala	‡2 1/16
British Col. Cop.	8⅝
Buffalo Mines	‡3½
Butte Coalition	26⅞
Colonial Silver	1/16
Cum. Ely Mining	8 3/16
Davis Daly	3¼
Dominion Cop	⅝
Douglas Copper	2⅞
El Rayo	3⅝
Florence	4 1/16
Foster Cobalt	.47
Furnace Creek	.13
Giroux	6⅝
Gold Hill	⅛
Goldfield Con	8 1/16
Granby	106½
Greene Gold	¼
Greene G. & S	7
Greenw'r & D.Val.	‡.75
Guanajuato	2
Guggen. Exp.	180
Hanapah	.15
McKinley Dar.	1.04
Micmac	2¼
Mines Co. of Am.	⅞
Mitchell Mining	⅛
Mont. Sho. C.	¾
Nev. Utah M. & S.	3
Newhouse M. & S.	6
Nipissing Mines	10⅜
Old Hundred	⅜
Silver Queen	1.02
Stewart	⅝
Tennessee Cop'r.	45¼
Tri-Bullion	1/16
Union Copper	¾
Utah Apex	5⅜
Utah Copper	47½
Yukon Gold	4 1/16

*Ex. Div. †Ex. Rights.

BOSTON	Dec. 29
Name of Comp.	Clg.
Adventure	9½
Allouez	37½
Am. Zinc	25½
Arcadian	3¼
Arizona Com	38¼
Atlantic	17⅛
Boston Con	17
Calumet & Ariz	118
Calumet & Hecla	675
Centennial	33¼
Con. Mercur	‡.38
Copper Range	81½
Daly-West	10⅛
East Butte	9¼
Franklin	17
Greene—Can	12½
Isle Royal	25¼
La Salle	14¾
Mass	6¼
Michigan	13¼
Mohawk	70
Nevada	19⅝
North Butte	85¼
Old Colony	‡.60
Old Dominion	58
Osceola	134¾
Parrot	30
Quincy	95
Rhode Island	‡5½
Santa Fe	2⅛
Shannon	17¾
Superior	34
Superior & Pitts	17⅛
Tamarack	82
Trinity	17
United Cop., com.	13⅝
U. S. Oil	‡28¾
U. S. Smg. & Ref.	44½
U.S.Sm. & Re.,pd.	46¾
Utah Con	46½
Victoria	4
Winona	‡6¼
Wolverine	152
Wyandotte	‡2½

‡Last quotation.

N. Y. INDUSTRIAL	
Am. Agri. Chem.	33½
Am. Smelt. & Ref.	83⅛
Am. Sm. & Ref. pf.	103
Colo. Fuel & Iron	39⅞
Federal M. & S.,pf.	‡83
National Lead	78½
National Lead, pf.	‡105¾
Pittsburg Coal	‡13¼
Republic I. & S.	26
Republic I.&S.,pf.	87½
Sloss-Sheffield	78
Standard Oil	690
U. S. Steel	54⅝
U. S. Steel, pf.	112⅞
Va. Car. Chem.	45

BOSTON CURB	
Ahmeek	135
Black Mt.	3
Chemung	22¾
Globe Con	7¾
Hancock	14⅞
Helvetia	4⅛
Keweenaw	5⅛
North Lake	7⅛
Ojibway	14¾
Superior & Bost.	17⅜

Furnished by Hornblower & Weeks, N. Y.

ST. LOUIS	Dec. 26	
N. of Com.	High.	Low.
Adams	.40	.30
Am. Nettie	.08	.05
Center Cr'k	2.00	1.50
Cent. C. & C.	79.00	78.00
C.C. & C. pd.	88.00	86.00
Cent. Oil	105.00	100.00
Columbia	7.00	4.00
Con. Coal	21.00	19.00
Doe Run	125.00	110.00
Gra. Bimet.	.30	.20
St. Joe	15.00	12.50

LONDON	Dec. 30
Name of Com.	Clg.
Dolores	£1 10s 0d
Stratton'sInd.	0 3 3
Camp Bird	0 16 0
Esperanza	3 6 0
Tomboy	1 0 7½
El Oro	1 6 0
Oroville	0 8 0

Cabled through Wm. P. Bonbright & Co., N. Y.

NEVADA STOCKS. Dec. 30.
Furnished by Weir Bros. & Co., New York.

Name of Comp.	Clg.
COMSTOCK STOCKS	
Belcher	.38
Best & Belcher	.46
Caledonia	.16
Challar	.08
Comstock	.27
Con. Cal. & Va.	.70
Crown Point	.38
Exchequer	.35
Gould & Curry	.09
Hale & Norcross	.31
Mexican	.81
Ophir	1.47
Overman	.20
Potosi	.13
Savage	.22
Sierra Nevada	.22
Union	.30
Utah	.04
Yellow Jacket	.64
TONOPAH STOCKS	
Belmont	.75
Extension	.48
Golden Anchor	.02
Jim Butler	.18
MacNamara	.32
Midway	.21
Montana	.65
North Star	.03
Tono'h Mine of N.	5.50
West End Con	.30
GOLDFI'D STOCKS	
Adams	.03
Atlanta	.18
Booth	.34
Columbia Mt.	.17
Comb. Frac.	1.56
Con. Red Top	.12½
Cracker Jack	.04
Dia'dfield B. B. C.	.11
Goldfield Belmont	.07
Goldfield Daisy	.68
Great Bend	.25
Jumbo Extension	.20
Kendall	.08
Lone Star	.05
May Queen	.05
N. Y. C. O. D.	.07
Oro	.12
Red Hill	.19
Roanoke	...
Sandstorm	.17

Name of Comp.	Clg.
Silver Pick	.10
St. Ives	.17
Triangle	.03
BULLFROG STOCKS	
Gibraltar	.03
Homestake King	.09
Mont. Shoshone C.	.87½
Tramp Cons	.09½
MISCELLANEOUS	
Bonnie Clare	.06
Lee Gold Grotto	...
Nevada Hills	1.37½
Nevada Smelting	1.00
Nevada Wonder	.35
Nevada-Utah	2.87½
Penn-Wyoming	.13
Pittsburgh S. Pk.	.86
Rawhide Coal	.45
Round Mt. Sphinx	.15

COLO. SPRINGS	Dec. 26
Name of Comp.	Clg.
Acacia	6½
Black Bell	....
C. C. Con	‡3½
Dante	5⅞
Doctor Jack Pot	8¼
Elkton	69
El Paso	50
Findlay	‡17½
Gold Dollar	9¼
Gold Sovereign	‡3½
Isabella	26¾
Index	....
Jennie Sample	6
Jerry Johnson	4
Mary McKinney	33
Pharmacist	3½
Portland	1.05
Un. Gold Mines	4⅞
Vindicator	80
Work	7

Assessments

Company.	Delinq.	Sale.	Amt.
Andes, Nev.	Jan. 8	Feb. 2	$0.10
Caledonia, Nev.	Jan. 8	Jan. 29	0.05
Challenge, Nev.	Dec. 11	Jan. 5	0.05
Chollar, Nev.	Jan. 11	Feb. 3	0.10
Copper King, Ida.	Dec. 10	Jan. 15	0.01
Ely Con., Nev.	Nov. 28	Jan. 11	0.02
Exchequer, Nev.	Dec. 30	Jan. 20	0.05
Federal-Ely, Utah	Jan. 9	Feb. 1	0.01
Iowa, Utah	Jan. 5	Feb. 2	0.02
Julia Con., Nev.	Dec. 21	Jan. 15	0.03
Lower Mammoth, Utah	Dec. 18	Jan. 8	0.05
Mountain Dell	Dec. 24	Jan. 12	0.02
New York Con., Nev	Dec. 18	Jan. 8	0.03
Oro Cobre, Cal.	Dec. 31	Jan. 16	0.02
Savage, Nev.	Jan. 6	Jan. 28	0.10
Silver King Con., Utah	Jan. 6	Jan. 26	0.10
Union Con., Nev.	Dec. 23	Jan. 14	0.10
Wabash, Utah	Jan. 7	Jan. 30	0.10
Yellow Jacket, Nev.	Dec. 28	Feb. 3	0.15

Monthly Average Prices of Metals

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	55.365	31.325	25.570
April	65.462	54.505	30.253	25.133
May	65.971	52.795	30.471	24.377
June	67.090	53.663	30.893	24.760
July	68.144	53.115	31.366	24.514
August	68.745	51.683	31.637	23.858
September	67.792	51.720	31.313	23.877
October	62.435	51.431	28.863	23.725
November	58.677	49.647	27.154	22.933
December	54.565	.....	25.362	.....
Year	65.327	.....	30.188	.....

New York, cents per fine ounce; London, pence per standard ounce.

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	12.704	25.560	12.875	106.594	58.761
April	24.224	12.743	25.260	12.928	98.625	58.331
May	24.048	12.598	25.072	12.788	102.375	57.387
June	21.665	12.675	24.140	12.877	97.272	57.842
July	22.130	12.702	21.923	12.933	95.016	57.989
August	18.356	13.462	19.255	13.639	79.679	60.500
September	15.565	13.388	16.047	13.600	68.375	60.338
October	13.169	13.354	13.551	13.646	60.717	60.139
November	13.391	14.130	13.870	14.386	61.226	63.417
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.

TIN AT NEW YORK

Month.	1907.	1908.	Month.	1907.	1908.
January	41.548	27.380	July	41.091	29.207
February	42.102	28.978	August	37.667	29.942
March	41.313	30.577	September	36.689	28.815
April	40.938	31.702	October	32.620	29.444
May	42.149	30.015	November	30.833	30.348
June	42.120	28.024	December	27.925	.....
			Av. year	38.160	.....

Prices are in cents per pound.

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	3.838	19.703	13.975
April	6.000	3.993	19.975	13.469
May	6.000	4.253	19.688	12 938
June	5.760	4.466	20.188	12.600
July	5.288	4.447	20.350	13.000
August	5.250	4.580	19.063	13.375
September	4.813	4.515	19.775	13.125
October	4.750	4.351	18.531	13 375
November	4.376	4.330	17.281	13.538
December	3.658	.....	14.500	.....
Year	5.325	.....	19.034	.....

New York, cents per pound. London, pounds sterling per long ton.

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	4.665	6.687	4.527	26 094	21.075
April	6.685	4.645	6.535	4.495	25.900	21.344
May	6.441	4.608	6.291	4.458	25.563	19.906
June	6.419	4.543	6.269	4.393	25.469	19.000
July	6.072	4.485	5.922	4.338	23.850	19.031
August	5.701	4.702	5.551	4.556	21.969	19.350
September	5.236	4.769	5.086	4.619	21.050	19.563
October	5.430	4.801	5.280	4.651	21.781	19.750
November	4.925	5.059	4.775	4.909	21.438	20.875
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.

CHEMICALS, MINERALS, RARE EARTHS, ETC.—CURRENT WHOLESALE PRICES.

ABRASIVES—

Bort, good drill quality, carat		$85.00
Carborundum, f.o.b. Niagara Falls, powd.	lb.	.08
Grains	"	.10@.17
Corundum	"	.07@.10
Crushed Steel, f.o.b. Pittsburg	"	.05½@.06
Emery, in kegs; Turkish flour	"	.01½@.02½
Grains	"	.03½@.04½
Naxos flour	"	.01½@.02½
Grains	"	.03½@.04½
Chester flour	"	.01½
Grains	"	.03½@.04½
Peekskill, f.o.b. Easton, Pa., flour	"	.01½@.01½
Grains, in kegs	"	.02½@.03
Garnet, per quality	sh. ton	25.00@35.00
Pumice Stone, Am. Powd., 100	lb.	1.60@2.00
Italian, powdered	"	.01½@.01½
Lump, per quality	"	.03@.20
Rottenstone, ground	"	.01½@.04
Lump, per quality	"	.05@.25
Rouge, per quality	"	.05@.30
Steel Emery, f.o.b. Pittsburg	"	.07½@.07½

ACIDS—

Acetic 28%	lb.	.021 up
Boric	"	.07
Hydrofluoric, 30%	"	.02½@.03
" 48%	"	.06
" 60%	"	.10
Hydrochloric acid, 20°, per lb.		1.25@1.50
Nitric acid, 38°	per lb.	4.25@4.62½c.
Sulphuric acid, 50°, bulk per ton.		$12 up
60°, 100 lb. in carboys.		.85@1.12½
60°, bulk, ton		16.00@18.00
66°, 100 lb. in carboys.		1.00@1.25
66°, bulk, ton		18.00
Oxalic	"	.06½@.06¾

ALCOHOL—Grain 95% | gal. | 2.63

Denatured	"	.47@.49
Refined wood, 95@97%	"	.50@.55

ALUM—Lump | 100 lb. | $1.75

Ground	"	1.85
Chrome Alum	"	.03½@.04

ALUMINUM—Sulphate, com'l. lb. 1.10@1.75

AMMONIA—24 deg. lb	"	.04½@.05½
" 26 deg. lb		.04½@.05½

AMMONIUM—

Bromide	lb.	.28
Carbonate	"	.07½@.08
Muriate grain	"	.05½@.06½
Lump	"	.09½@.09½
Sulphate, 100 lb		3.05@3.10
Sulphocyanide com	"	.30
" chem. pure	"	.40

ANTIMONY—needle, lump	"	.03½@.03¾
ARSENIC—White	"	.03½@.03¾
Red	"	.07½@.07½

ASPHALTUM—

Barbadoes	per ton.	40.00@80.00
West Indies	"	20.00@60.00
Egyptian	lb.	.10@.11
Gilsonite, Utah ordinary	per ton.	32.00
Trinidad	"	22.50@30.00
California	"	21.00@27.00

BARIUM—

Carb. Lump, 80@90%	lg. ton.	30.00@35.00
Precipitated 96@98%		36.00@40.00
Powdered, 80@90%	lb.	.02@.02½
Chloride com'l	ton.	39.00@41.00
Nitrate powdered, in casks	lb.	.05½@.06
Blanc Fixe	per lb.	.02½

BARYTES—

Am. Ground	sh. ton.	14.00@17.50
Floated	"	18.00@21.00
Foreign floated	"	19.50@22.50

BISMUTH—Sub-nitrate	lb.	1.50
BLEACHING POWDER—35%, 100 lb		1.25@1.40
BLUE VITRIOL—(copper sulphate), carload, per 100 lb.		4.75
BONE ASH	lb.	.02½@.04
BORAX, sacks	"	.04½

CALCIUM—Acetate, gray, 100 lb | 1.50@1.55

Acetate, brown	lb.	1.00@1.05
Carbide, ton lots f.o.b. Niagara Falls, N. Y., for Jersey City, N. J.	sh. ton.	65.00
Chloride, f.o.b. N. Y.	"	11.00@14.00

CEMENT—

Portland, Am. 500 lb	bbl.	1.55@1.60
Foreign	"	2.25@2.90
"Rosendale," 300 lb	"	.85
(in sacks)	"	.65
Slag cement	"	.75@1.25

CHROME ORE—

New Caledonia 50% ex. ship N. Y.	per lg. ton.	17.50@20.00
Bricks, f.o.b. Pittsburg, M	ton.	175.00

CLAY, CHINA—Am. common ex-dock, N. Y. | ton. | 8.00@9.00

Foreign	"	10.00@17.50
COBALT—Oxide	lb.	1.40

COPPERAS—Bulk | 100 lb. | $0.9

In bbls	"	.65@.75
In bags	"	.60@.70
CRYOLITE	lb.	.06½@.06¾
FELDSPAR—Ground best	sh. ton.	10.50@15.00

FIRE BRICK—

American	per M.	30.00@40.00
Imported	"	30.00@45.00
St. Louis No. 1	"	18.00
" No. 2	"	15.00
Extra	"	20.00@23.00

FIRE CLAY—F.o.b. St. Louis.

St. Louis, extra quality	per ton.	5.00
" ordinary	"	2.50

Dowestic f.o.b. shipping port:

FLUORSPAR—

Domestic f.o.b. shipping port:		
Lump	lg. ton.	8.00@10.00
Ground	"	11.50@13.50
Foreign crude ex. dock		8.00@10.00

FULLER'S EARTH—Lump, 100 lb. .75@.85

Powdered	"	.75@.85

GRAPHITE—Ceylon.

Flying dust, finest to best	lb.	.02½@.04
Dust	"	.02½@.05
Chip	"	.04@.08
Lump	"	.05½@12
Large lump	"	.08½@.10½

GYPSUM—

Feritlizer	sh. ton.	5.00
Ground	"	4.00@7.00

INFUSORIAL EARTH—

Ground Am. Best	lb.	.01½
German	lb.	.02½@.02½

LEAD—Acetate (sugar of) brown, lb. .07½

Nitrate, com'l	"	.08½@.08¾

MAGNESITE—Greece.

Crude (95%)	lg. ton.	8.00@10.00
Calcined, powdered	sh. ton.	26.00@35.00
Bricks, domes, per qual. f.o.b. Pittsburg	M.	160@200

MAGNESIUM—

Chloride, com'l	100 lb.	.90@1.25
Sulphate (Epsom salt)	100 lb.	.85@1.00

MANGANESE—

Foreign, crude, powdered:		
70@75% binoxide	lb.	.01@.01½
75@85% binoxide	"	.01½@.01½
85@90% binoxide	"	.01½@.05
90@95% binoxide	"	.06½
Ore, 80%-85%	sh. ton.	16.00@32.50

MARBLE—Flour | sh. ton. | 8.50@10.00

MINERAL WOOL—

Slag, ordinary	sh. ton.	19.00
Selected	"	25.00
Rock, ordinary	"	32.00
Selected	"	40.00

MONAZITE SAND—

Guar. 97%, with 5% Thorium oxide, nominal	lb.	.08 and up

NICKEL—

Oxide, crude, lb. (77%) for fine metal contained		.47
Sulphate, single	lb.	.09@.11
Sulphate, double	"	.06½@.08

NITRATE OF SODA—100 lb. 95% for '08 2.17½

95% for 1909	2.17½
95% for 1910	2.17½
96% is 2½@7½c. higher per 100 lb.	

OZOKERITE—best | lb. | .14@.17

PAINTS AND COLORS—

Litharge, Am. powdered	lb.	.06½@.07
English glassmakers'	"	.08½@.08½
Lithopone	"	.03½@.07
Metallic, brown	sh. ton.	16.50@22.00
Red	"	14.00@18.00
Ocher, Am. common	"	8.50@9.00
Best	"	16.00
Dutch, washed	lb.	.02½@.03
French, washed	"	.01½@.02½
Paris green, pure, bulk	"	.21½
Red lead, American	"	.06½@ 07
Foreign	"	.08½@.08½
Turpentine, spirits bbl., per gal.		.41½
White lead, Am., dry	lb.	.05½@.05½
American, in oil	"	.06½@.06½
Foreign, in oil	"	.10½@.10½
Zinc white, Am. extra dry	"	.05½@.05½
French, red seal, dry	"	.08½@.08½
French, Green seal, dry	"	.10½@.10½

PHOSPHATES—Acid | 60c. per unit

*Fla., hard rock	10.00@10.25
land pebble 68%	4.25@4.50
†Tenn., 78@80%	6.00@6.50
75%	5.00@5.50
68@72%	4.00@4.50
‡So. Car. land rock	6.75@7.00
" " river rock	5.00@5.50

*F.o.b. Florida or Georgia ports. †F.o.b. Mt. Pleasant. ‡On vessel Ashley River, S. C.

POTASSIUM—

Bicarbonate crystal	lb.	$.08½@.09
Powdered or granulated	"	.09@.09½
Bichromate, Am.	"	.08½@.08½
Scotch	"	.10½
Bromide	"	.20
Carbonate (80@85%)	"	.03½@.04
Caustic, ordinary	"	.04½@.05½
Elect. (90%)	"	.05½@.06
Chloride (muriate), 100 lb		1.90
Chlorate, powdered	"	.09½@.09½
Crystals	"	09@09½
Cyanide (98@99%)		
Carloads (30,000 lb.)	"	18c.
5-ton lots	"	18½c.
Less than 5 tons	"	19c.

Kainite, long ton, bulk, 8.50; bags, 9.50.

Permanganate	lb.	.09½@.10
Prussiate, yellow	"	.13@.13½
Red	"	.30@.33
Sulphate	100 lb.	2.18½@2.21½

PYRITE—

Domestic, non-arsenical, furnace size, f.o.b. mines	per unit. 11@11½c.
Domestic, non-arsenical, fines, per unit, f.o.b. mines	10@10½ c
Imported non-arsenical, furnace size, per unit	.12½
Imported, arsenical, furnace size, per unit	.12
Imported fines, arsenical, per unit.	.08½@.09
Imported fines, non-arsenical, per unit	10½@11c.

Pyrite prices are per unit of sulphur. An allowance of 25c. per ton is made when delivered in lump form.

SALT—N. Y. com. fine 280 lb.	bbl.	.72@1.13
N. Y. agricultural	sh. ton.	3.80@4.50
SALTPETER—Crude	100 lb.	4.00@4.50
Refined, crystals	"	5.50@6.00

SILICA—

Ground quartz, ord'ry.	lg. ton.	10.00@15.00
Silex, ground	"	13.00@15.00
Silex, floated	"	35.00@40.00
Lump quartz	"	5.00@6.00
Glass sand	"	2.75

SILVER—Nitrate, crystals	oz.	.37½@.40

SODIUM—

Acetate	lb.	.04@.04½
"Alkali," per 100 lb., 58/48		.80@.87½
Bicarb. soda, per 100 lb		1.00@1.30c.
Soda, caustic, per 100 lb., 76/60		1.75@1.85
Soda, caustic, powdered		.02½@.03½
Salt cake, per 100 lb., bulk		.40
Salt cake, bbl		.65@.85
Soda, monohydrate, per lb		1.4@1.75c.
Bichromate	lb.	.06½@.07
Bromide	"	.13@.14
Chlorate, com'l	"	.09@.09½
Cyanide ("100% KCN")		
Carloads (30,000 lb.)	"	18c.
5-ton lots	"	18½c.
Less than 5 tons	"	19c.
Hyposulphite, Am.	"	1.35 up
German	"	1.60@1.70
Phosphate	100 lb.	2.00@2.20
Prussiate	"	.08@.08½
Sal soda, f.o.b. N. Y.	"	.65@.70
Foreign, f.o.b. N. Y.	"	.80@1.00
Silicate, com'l.	"	.80@1.15
Sulphate, com'l (Glauber's salt)	100 lb.	.60@.75
Sulphate, com'l, calcined		.65@.85

STRONTIUM—Nitrate	lb.	.07½@.08

SULPHUR—

Louisiana (prime) to New York, Boston or Portland	lg. ton.	22.50
To Philadelphia or Baltimore	"	22.50
Roll	100 lb.	1.85@2.15
Flour	"	2.00@2.40
Flowers, sublimed	"	2.20@2.60

TERRA ALBA—French & Eng.	100 lb.	.85@1.00
TALC—Domestic	sh. ton.	15.00@25.00
French	"	16.00@25.00
Italian, best	"	35.00@40.00
TIN—Bi-chloride, 50%	lb.	.09½ up
Crystals	"	.21 up
Oxide, lb	"	.33@.35
URANIUM—Oxide	"	3.50

ZINC—

Chloride solution, com'l 20°	"	.02½
Chloride, granular	"	.04½@.05
Dust	"	.04½@.05
Sulphate	"	.02@.02½

NOTE—These quotations are for ordinary wholesale lots in New York unless otherwise specified, and are generally subject to the usual trade discounts. In the cases of some of the important minerals, such as phosphate rock, pyrites, and sulphur, in which there are well established markets, the quotations fully represent the latter. But in the cases of some of the minor mineral products, the quotations represent what dealers ask of consumers and not what producers can realize in selling their outputs as matters of private contract.